UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

NOV 17 2006

In response refer to:
2005/07420

Magalie R. Salas
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Dear Ms. Salas:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) preliminary biological opinion (Enclosure 1) based on our review of the Federal Energy and Regulatory Commission's (FERC) proposed relicensing of Pacific Gas and Electric Company's (PG&E) DeSabla-Centerville project (FERC No. 803), in Butte County, California, and its effects on Federally listed threatened Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*; CV spring-run Chinook salmon), and their designated critical habitat in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your October 11, 2005, request for early formal consultation was received on October 19, 2005. Formal consultation was initiated on October 19, 2005. Although portions of the action area are occupied by Central Valley steelhead (*O. mykiss*; CV steelhead) and is designated critical habitat for this species, at the request of FERC and PG&E, this early consultation only addresses potential impacts to CV spring-run Chinook salmon and their designated critical habitat because high mortalities of adult Butte Creek spring-run Chinook salmon holding over the summer in 2002 and 2003 prompted an immediate need to evaluate project-related effects on the species. Potential effects of the project on CV steelhead and their designated critical habitat will be analyzed in a final biological opinion prior to FERC issuing a new license for the project in 2009.

This biological opinion is based on information provided in the August 16, 2005 biological assessment (BA) which was received on October 19, 2005, and discussions held at meetings with representatives of NMFS, PG&E, and the California Department of Fish and Game (CDFG). A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

Based on the best available scientific and commercial information, the biological opinion concludes that this project is not likely to jeopardize CV spring-run Chinook salmon or adversely modify their designated critical habitat. NMFS also has included a preliminary incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to minimize incidental take associated with the issuing a 50-year license for FERC No. 803.

The preliminary incidental take statement will not be effective until NMFS assesses the effects of the project on Central Valley steelhead, revises the incidental take statement to include Central Valley steelhead, and adopts the preliminary biological opinion as the final biological opinion. Furthermore, because this is an early consultation on the prospective action, this preliminary incidental take statement does not eliminate FERC or PG&E's liability under the taking prohibitions of section 9 of the ESA. Instead, this statement provides your agency and the applicant with foreknowledge of the terms and conditions for CV spring-run Chinook salmon that will be required if the proposed action is filed with your agency. These reasonable and prudent measures and the implementing terms and conditions become effective only after NMFS confirms the preliminary biological opinion as a final biological opinion on the proposed action.

If you have any questions regarding this correspondence please contact Mr. Howard Brown in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814. Mr. Brown may be reached by telephone at (916) 930-3608 or by Fax at (916) 930-3629.

Sincerely,

Anthony G. Morton

for Rodney R. McInnis
Regional Administrator

Enclosure (1)

cc: NMFS-PRD, Long Beach, California
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PRELIMINARY BIOLOGICAL OPINION

ACTION AGENCY:	Federal Energy and Regulatory Commission Washington, DC
ACTIVITY:	Proposed Issuance of a new license for the Pacific Gas and Electric Company's DeSabla-Centerville Hydroelectric project (FERC No. 803)
CONSULTATION CONDUCTED BY:	NOAA's National Marine Fisheries Service
FILE NUMBER:	151422SWR1999SA1221:HLB
DATE ISSUED:	NOV 17 2006

I. CONSULTATION HISTORY

Since 1999, the Pacific Gas and Electric Company (PG&E), NOAA's National Marine Fisheries Service (NMFS), the California Department of Fish and Game (CDFG), and the U.S. Fish and Wildlife Service (USFWS) have collaborated annually on the development of an Operations and Maintenance Plan for PG&E's DeSabla-Centerville project. These plans have guided the implementation of operational refinements designed to provide summer water temperatures that are as cold as possible for Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*; CV spring-run Chinook salmon), in Butte Creek. As part of its ongoing investigation into the relationship between the DeSabla-Centerville project and the needs of CV spring-run Chinook salmon, PG&E has conducted numerous studies and collected extensive data to support the annual Operations and Maintenance Plans. As a result of these efforts, PG&E and the resource agencies have identified areas where further study, modeling, and analysis may help to shape new approaches to project operation.

Since November 2002, PG&E, acting as the Federal Energy and Regulatory Commission's (FERC) designated non-Federal representative, has been engaged in informal section 7 consultation with NMFS.

On September 3, 2003, in response to high summer mortalities of pre-spawning adult spring-run Chinook salmon in 2002 and 2003, NMFS provided FERC with 11 recommendations for avoiding or minimizing future mortalities in Butte Creek. NMFS also recommended that FERC initiate a formal Endangered Species Act (ESA) section 7 consultation.

Between September 2003 and July 2005, NMFS met with PG&E and FERC to discuss options for initiating a formal section 7 consultation concurrent with relicensing the project.

On October 4, 2004, PG&E filed a Notice of Intent (NOI) with the FERC to seek a new license for the project. The current license expires on October 11, 2009.

In December 2004, in anticipation of relicensing the project, PG&E requested that FERC enter into early consultation with NMFS under section 7(a)(3) of the ESA to evaluate the potential effects of the prospective project relicensing on CV spring-run Chinook salmon. The early consultation provisions of the ESA afford an opportunity for early coordination and resolution of issues relating to the effects of a pending project on listed species and critical habitat, thereby reducing the likelihood of conflict between ESA requirements and the proposed Federal action. In response to PG&E's request, both FERC and NMFS agreed that early consultation would help resolve in advance the project-related issues affecting CV spring-run Chinook salmon, and allow for preliminary findings to be made regarding the consistency of the project with the ESA. Both parties agreed to limit the scope of the early consultation to CV spring-run Chinook salmon and their designated critical habitat. The effects of the proposed action on Central Valley steelhead (*Oncorhynchus mykiss*; CV steelhead) will be analyzed in the final biological opinion. This decision was made because high mortalities of adult Butte Creek spring-run Chinook salmon holding over the summer in 2002 and 2003 have prompted an immediate need to analyze project-related effects on adult pre-spawning survival within the project area.

On July 15, 2005, PG&E provided NMFS with a draft biological assessment (BA) evaluating the potential effects of the DeSabla-Centerville project on CV spring-run Chinook salmon and their critical habitat.

On August 10, 2005, NMFS provided review comments on the draft BA.

On October 11, 2005, FERC requested early consultation with NMFS for PG&E's DeSabla-Centerville project in Butte County, California. The request for consultation included a final BA for the DeSabla-Centerville project (FERC No. 803).

On October 19, 2005, NMFS initiated early consultation to assess the effects of the DeSabla-Centerville project on CV spring-run Chinook salmon and their designated critical habitat.

This biological opinion is based on information provided in the BA, and discussions at meetings held since November 2002, involving staff from NMFS, PG&E, CDFG, FERC, and the USFWS. A complete administrative record of this consultation is on file at the NMFS Sacramento Field Office.

II. DESCRIPTION OF THE PROPOSED ACTION

FERC proposes to issue a 50-year license to PG&E for the continued operation of the DeSabla-Centerville Hydroelectric project (FERC No. 803). FERC is an independent Federal agency that regulates natural gas and hydropower projects and the interstate transmission of natural gas, oil, and electricity. As part of its responsibilities, FERC licenses and inspects private, municipal, and state hydroelectric projects pursuant to the Federal Power Act (FPA). Under section 4 of the FPA, FERC is authorized to "issue licenses to citizens, corporations, municipalities, and state governments for the purpose of constructing, operating, and maintaining dams, water conduits, reservoirs, power houses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission, and utilization of power across, along, from, or in any of the streams or other bodies of water over which Congress has jurisdiction...." 16 U.S.C. § 797.

The DeSabla-Centerville project is a 26.6 megawatt (MW) installed capacity hydroelectric facility, within the West Branch Feather River (WBFR) and Butte Creek watersheds. PG&E is not proposing to add capacity or make major modifications to the project at this time. The project consists of 3 reservoirs, 3 powerhouses, 14 diversion and feeder dams, 5 canals and associated equipment and transmission facilities. PG&E operates the project primarily as a run-of-river system, using the water supply available after meeting minimum instream flow requirements. During the winter and spring, base flows in the WBFR and Butte Creek typically provide adequate flow for operation of the project powerhouses. During the summer months, the available base flow water is augmented by releases from Round Valley and Philbrook reservoirs. During the fall months, project powerhouses are operated at reduced capacities due to low stream flows.

The proposed project would continue to rely on flows from both the WBFR and Butte Creek. In the WBFR, releases from Round Valley and Philbrook Reservoirs pass down the natural channels of Philbrook Creek and the WBFR about 8 miles to Hendricks Head Dam. From this point, the water is conveyed by the 8.66 mile-long Hendricks Canal (125 cubic feet per second (cfs) capacity) to Toadtown Canal (125 cfs capacity), through Toadtown Powerhouse (1.5 MW), then 2.43 miles to Butte Creek Canal (191 cfs capacity), and then 0.73 mile to DeSabla Forebay (188 acre-feet). Water also is diverted from Butte Creek at the Butte Creek Diversion Dam into the Butte Canal (91 cfs capacity). Water from the Butte Canal joins the Toadtown Canal approximately 0.7 miles before entering the DeSabla Forebay. After passing through DeSabla Powerhouse (18.5 MW), flow is discharged to Butte Creek. A short distance downstream of DeSabla Powerhouse is the Lower Centerville Diversion Dam (LCDD) where flow is diverted into the Lower Centerville Canal (180 to 185 cfs capacity) to Centerville Header Box, and through Centerville Powerhouse (5.8 MW), finally discharging to Butte Creek. A minimum instream flow of 40 cfs is maintained below the LCDD.

A. General Project Operations and Relationship to Existing Project Facilities

The existing project facilities, including dams, canals, powerhouses, and reservoirs, have been in place for about 100 years. PG&E is not proposing any new facilities or substantial modifications to the existing facilities at this time.

The project diverts the natural flow of water from Butte Creek and the WBFR into canals that carry the water for use in the three hydroelectric powerhouses. Once water is run through the powerhouses, it is ultimately released to Butte Creek. During the summer, the natural flow of the WBFR is augmented by water releases from Round Valley and Philbrook reservoirs. Project diversions from the WBFR, including both natural flow and water releases from storage, have provided additional flow to Butte Creek for over 100 years. The following sections provide a description of the project features, organized by river basin and elevation. Figure 1 shows a map of the project area with important project features and stream channels.

1. West Branch Feather River Facilities

The WBFR drainage basin ranges in elevation from approximately 7,000 feet to approximately 3,200 feet at PG&E's diversion point at the Hendricks Head Dam. Philbrook and Round Valley Reservoirs are used to store winter runoff, which is later used to supplement summer flows in the WBFR. These reservoirs have a combined storage capacity of 6,200 acre-feet.

a. *Round Valley Reservoir*

Round Valley Reservoir is located at the upper end of the action area in the WBFR more than 12 river miles (RM) upstream of Hendricks Head Dam. Round Valley Reservoir has a maximum depth of approximately 25 feet, with a storage capacity of approximately 1,200 acre-feet and a spillway elevation of 5,651.1 feet. The Round Valley Reservoir Dam consists of a simple overflow spillway and has no gates or flashboards. Water releases are made through a manually operated low level outlet valve at the upstream end of the outlet pipe at the base of the dam. The WBFR is joined by Coon Hollow Creek approximately 1.3 RM downstream of Round Valley Reservoir Dam.

Under the terms of a 1983 Fish and Wildlife Agreement between PG&E and CDFG, PG&E refrained from drafting from Round Valley Reservoir during normal water years until after July 15 to improve waterfowl habitat management. However, on August 21, 1997, FERC issued an order placing a restriction on the release of water from the reservoir when the water temperature exceeded 17 °C. On August 20, 1998, FERC revised its order to allow for modification of the temperature criteria upon mutual agreement of NMFS, CDFG, and the USFWS. Since 1999, these agreements have been reflected in annual project Operations and Maintenance Plans developed by PG&E in consultation with the resource agencies governing water releases from both Round Valley and Philbrook reservoirs.

The annual project Operations and Maintenance Plans have consistently directed the release of water from Round Valley Reservoir immediately upon the availability of space in Hendricks Canal, which typically occurs in June. Once these releases begin, the Round Valley Reservoir drains completely in about one month. No minimum storage requirement has been set for this reservoir.

b. *Philbrook Dam and Reservoir*

Philbrook Reservoir is on Philbrook Creek, a tributary to the WBFR, and is located about 20 miles northeast of Paradise, California. Philbrook Reservoir has a maximum depth of about 60 feet, with a storage capacity of approximately 5,000 acre-feet and a normal maximum water surface elevation of 5,552.5 feet. The reservoir is located more than 10 RMs upstream of the Hendricks Head Dam. Article 39 of the existing project license requires that a minimum pool of no less than 250 acre-feet and minimum instream flow release of 2 cfs at the dam be maintained. Although FERC's August 21, 1997 order also placed a temperature restriction of 18 °C on water released from Philbrook Reservoir, its subsequent August 20, 1998 order allowed for modification of the temperature criteria upon mutual agreement of PG&E, NMFS, CDFG, and the USFWS.

Pursuant to the annual project Operations and Maintenance Plans developed in consultation with the resource agencies, water releases from Philbrook Reservoir typically occur as the releases from Round Valley Reservoir start to diminish. Drafting is generally planned so that approximately 500 to 750 acre-feet remain in Philbrook Reservoir in mid-September to ensure that water is available to maintain minimum instream flow releases until the onset of winter rains. The confluence of Philbrook Creek and the WBFR is 2 river miles downstream of the Philbrook Dam.

c. *Hendricks Head Dam and Canal*

Hendricks Canal is 8.66 miles long and is composed mostly of earthen ditch with several flume and tunnel sections. The canal originates at the Hendricks Head Dam, a concrete gravity dam on the WBFR that is approximately 15 feet high with an overflow spillway section 98 feet wide. The crest elevation of the dam is 3,256 feet. During low flow periods, the entire flow of the WBFR is diverted into the canal with the required minimum flow released back into the WBFR just downstream of the dam. The instream flow releases are maintained at a minimum of 15 cfs in normal water years and 7 cfs in dry water years. The maximum capacity of Hendricks Canal is 125 cfs.

The first section of the canal consists of a short open canal segment and an approximately 4,800-foot tunnel that conveys water under Stirling City to Long Ravine where it is released. The water then flows down Long Ravine where it is again captured at Long Ravine Diversion Dam, located approximately 2.4 miles downstream from WBFR and Hendricks Head Dam. The Long Ravine Diversion Dam is approximately 40 feet wide and is composed of a concrete foundation and timber flashboards approximately 6 feet high. Beyond this diversion dam, the canal continues to follow the contour of the land, along well-shaded areas until it reaches the Lovelock Tunnel. Flows in Hendricks Canal are supplemented by feeder diversions on Long Ravine, Cunningham Ravine, Little West Fork Feather River, and Little Butte Creek. Minimum instream flow releases downstream of the feeder diversions are set by Article 39 of the existing license.

d. *Toadtown Powerhouse*

Toadtown Powerhouse receives water from Hendricks Canal through a welded steel penstock. The powerhouse is located 8.66 miles downstream of Hendricks Head Dam and its main floor sits at an elevation of approximately 2,825 feet. No storage reservoir is associated with the powerhouse. Toadtown Powerhouse consists of a reinforced concrete building approximately 28 feet by 44 feet, which houses one turbine-generator unit. The generator is a Francis turbine which has a normal maximum gross head of 185 feet, a rated flow of 134 cfs, with a normal operating capacity of 1.5 MW. The minimum operating flow through the powerhouse is approximately 25 cfs. In the event that flows in the Hendricks Canal fall below minimum operating levels, water is directed through the Rapid Pipe bypass.

e. *Toadtown Canal*

Toadtown Canal begins at the tailrace (*i.e.*, outlet) of Toadtown Powerhouse. The canal is primarily made of earthen material and operates at a capacity of 125 cfs. Toadtown Canal joins Butte Canal approximately 0.7 miles above DeSabla Forebay. The total length of the Toadtown Canal is about 2.4 miles.

2. <u>Butte Creek Facilities</u>

The Butte Creek drainage basin ranges in elevation from 7,100 feet to 550 feet at Centerville Powerhouse. The facilities include a diversion dams, canals, forebays, and powerhouses. There are no water storage reservoirs.

a. *Butte Creek Diversion Dam and Canal*

The project first diverts water from Butte Creek at the Butte Creek Diversion Dam, a concrete arch dam approximately 50 feet high into the Butte Canal. The dam has an overflow spillway at an elevation of 2,884 feet. The 11.4-mile Butte Canal has a capacity of approximately 91 cfs. Butte Canal consists of sections of earthen berm, gunite, tunnels, a siphon, and flume. The canal generally follows the contour of the hillside along Butte Creek, running through well-shaded areas.

Approximately 0.7 miles above DeSabla Forebay, Butte Canal and Toadtown Canal join. At this juncture, canal capacity increases to 191 cfs. Flow in Butte Canal is supplemented by feeder diversions on three streams, Inskip Creek, Kelsey Creek, and Clear Creek. A feeder was also originally constructed at Stevens Creek, but its use has been discontinued. The stream sections below these points of diversion are relatively short and steep.

b. *DeSabla Forebay and Dam*

DeSabla Forebay is formed by an earthen embankment approximately 50 feet high and 250 feet thick at the base, with a width of 100 feet at the crest. A spillway canal leading to a small ravine is located just north of the dam. The spillway elevation is 2,755 feet. PG&E manages the inflow to DeSabla Forebay to avoid spill, and spill rarely occurs. DeSabla Forebay originally operated at a capacity of 188 acre-feet; however, sedimentation has since reduced this capacity significantly. The surface area of the forebay is approximately 15 acres at maximum capacity. DeSabla Forebay is a regulating facility for DeSabla Powerhouse. However, the powerhouse and associated intake is float-controlled and the forebay fluctuates minimally during normal operations. The forebay is stocked annually with trout by CDFG and is popular with local fishermen and summer recreationists.

c. *DeSabla Powerhouse*

DeSabla Powerhouse receives water from DeSabla Forebay through a welded steel penstock, and discharges water directly into Butte Creek above Lower Centerville Diversion Dam. The powerhouse is located approximately 1.3 miles downstream of DeSabla Forebay and sits at an elevation of 1,222 feet. DeSabla Powerhouse is a reinforced-concrete structure with a control building measuring approximately 26.5 feet by 41 feet, with one turbine-generator unit. The turbine unit is a 25,000 horsepower (hp) Pelton horizontal turbine with a normal maximum gross head of 1,530 feet, a flow of 191 cfs, and a normal operating capacity of 18.5 MW. The powerhouse operates at a satisfactory level during the low flow conditions typical in the fall; minimum unit loading has not been a concern.

d. *Upper Centerville Canal*

The Upper Centerville Canal originates at DeSabla Powerhouse and ends at Helltown Ravine where water may be released and later recaptured at the crossing of Helltown Ravine and Lower Centerville Canal. The canal was used historically as an alternate route to direct water to Centerville Powerhouse when the DeSabla Powerhouse was out of service. However, the Upper Centerville Canal has not been used to convey water for power generation for many years and currently carries only a few cfs for local water users.

e. *Lower Centerville Diversion Dam and Canal*

The Lower Centerville Diversion Dam (LCDD) diverts up to approximately 183 cfs from Butte Creek below DeSabla Powerhouse into the Lower Centerville Canal. The dam is a concrete arch dam approximately 12 feet high with an overflow spillway at crest elevation 1,146 feet. During periods of low flow the entire flow of Butte Creek is captured at the diversion intake. After making a minimum instream flow release of 40 cfs below the dam, the remaining flow is diverted into Lower Centerville Canal. Beginning in 2004, flows released below the dam were increased to 60 cfs during the spawning period, from late September through February, to increase spawning habitat. The 2005 Operations and Maintenance Plan increased instream flow releases during this period to approximately 75-80 cfs to further enhance conditions for CV spring-run Chinook salmon. Lower Centerville Canal is approximately 8 miles long and is composed of earthen canal and several flume sections. It is more exposed to solar radiation than either the Hendricks or Butte canals. Lower Centerville Canal carries water to Centerville Powerhouse.

Flows in Lower Centerville Canal historically have been supplemented by three feeder diversions on Oro Fino Ravine, Emma Ravine, and Coal Claim Ravine. Use of these feeders has been discontinued. The minimum instream flow release requirements below these feeder diversions are set out in Article 39 of the current project license.

f. *Centerville Powerhouse*

Centerville Powerhouse is fed by water from Lower Centerville Canal through two riveted steel penstocks. The main floor of the facility sits at an elevation of 475 feet. The intake structure to the penstock is a 27 feet by 37 feet concrete header box with a spillway channel that is used in the event a generator trips off line. The spillway is also typically used in the fall if only the smaller of the two generating units is operating. The powerhouse discharges water directly into Butte Creek about 5.3 miles downstream of LCDD. Centerville Powerhouse is a concrete reinforced stone building measuring approximately 32 feet by 109 feet and houses two turbine-generator units. Unit 1 is a 9,700 hp horizontal Francis turbine and Unit 2 is a 1,500 hp horizontal Pelton turbine. The combined two units have a normal maximum gross head of 590 feet, a flow of 183 cfs, and a total maximum operating capacity of 5.8 MW. The minimum operating flow for Unit 1 is approximately 60 cfs. Unit 1 is equipped with a load controller and is more efficient than Unit 2. If sufficient water is not available for operation of Unit 1, the smaller Unit 2 can be run off very low flows, possibly as low as 5 cfs. However, as Unit 2 has no load controller, it is necessary to set operation of the unit flow below the level of flow in the Lower Centerville Canal to insure that the penstock remains full. The surplus water that results from this operation is spilled down the bypass channel and into Butte Creek.

During times of flow in the spillway channel, PG&E visually inspects the water in the channel when an operator is present. If turbidity is present, PG&E investigates the source of the turbidity and attempts to take corrective action. After an outage, and consistent with the annual Project Operations and Maintenance Plan, PG&E consults with the resource agencies (i.e., NMFS, USFWS, USFS, CDFG, and SWRCB) and returns the water to the canals in a manner that minimizes turbidity and the transport of material to surface waters. PG&E monitors water quality (grab samples tested for turbidity and settleable solids) hourly for a period of up to four hours. For the start-up of Centerville Powerhouse, the monitoring location is at the bridge downstream of Centerville Powerhouse; for the start-up of DeSabla Powerhouse, the monitoring location is LCDD.

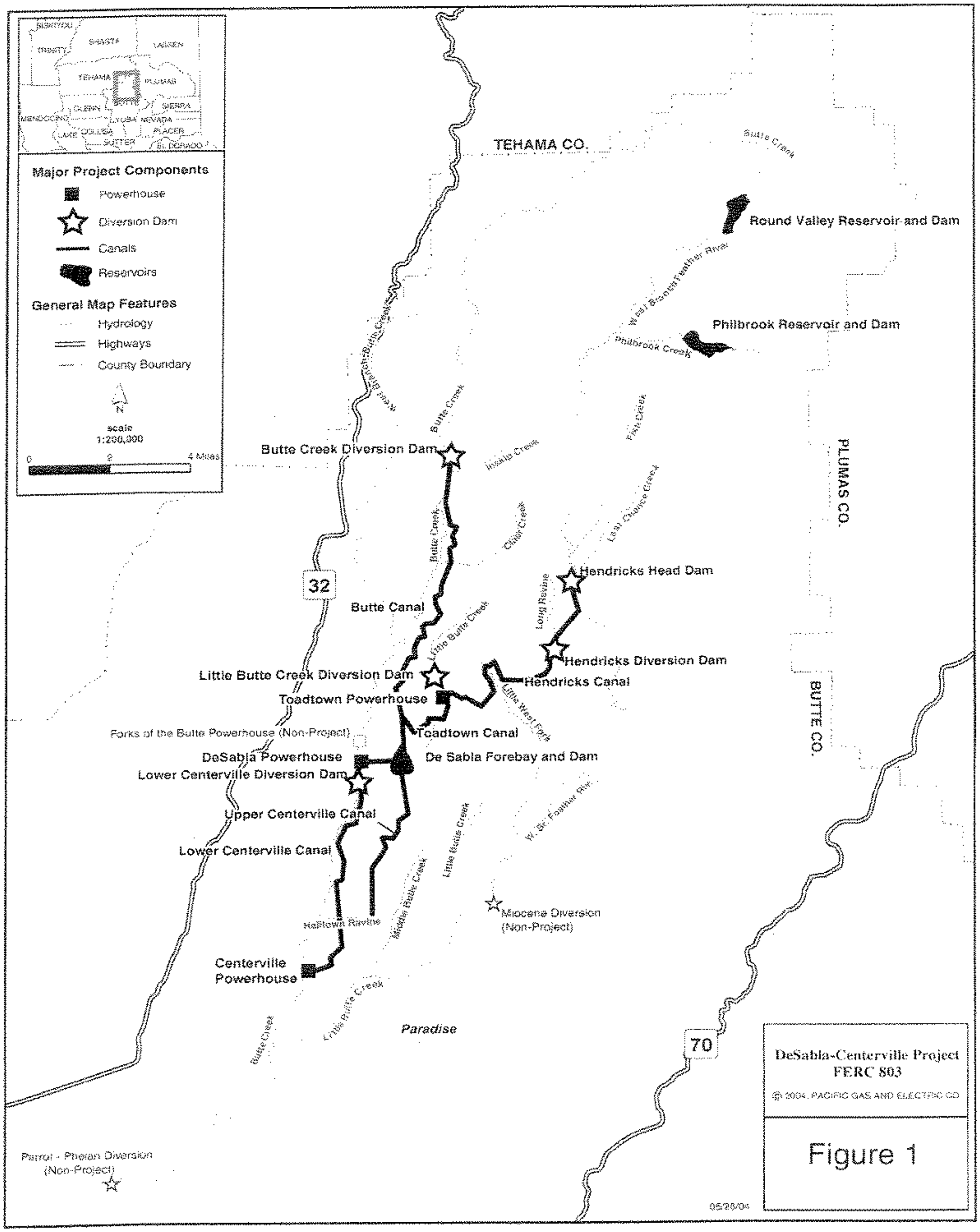

Figure 1. Map of the DeSabla-Centerville project, and major drainages in the Butte Creek and WBFR watersheds.

B. Project Operations

Since 1999, PG&E has operated the project under an annual Project Operations and Maintenance Plan developed each spring in consultation with the resource agencies. The 2005 Project Operations and Maintenance Plan details the current operations and maintenance procedures (Appendix A). The 2005 Project Operations and Maintenance Plan describes an adaptive management strategy for maintaining water temperatures in adult CV spring-run Chinook salmon summer holding habitat that is as cold as possible. FERC and PG&E propose to continue to use the framework and adaptive management strategy of the 2005 plan to develop annual plans for future operations and maintenance.

Under the Project Operations and Maintenance Plans, water is released from reservoirs on the WBFR, first from Round Valley Reservoir, followed by the release of water from Philbrook Reservoir. These releases, together with the diversion of natural flow from the WBFR, provide an additional source of cool water to Butte Creek. To minimize the amount of solar heating that may occur as the water travels from the WBFR to Butte Creek, the Project Operations and Maintenance Plans have included measures to maintain a minimum flow of 100 cfs into the DeSabla Forebay through mid-September. This measure decreases the time required for conveyance through the forebay.

Conservation measures incorporated into project operations are set forth in detail in the 2005 Project Operations and Maintenance Plan and discussed in Chapters 4 and 5 of the BA. Some of the most significant measures that have been incorporated into the proposed project for the benefit of CV spring-run Chinook salmon include the following:

1. Water releases from Round Valley Reservoir will occur as soon as capacity is available in the Hendricks Canal. This action is designed to minimize the potential for water temperature increases in Round Valley Reservoir and to preserve the cool water benefits of Philbrook Reservoir.

2. Philbrook Reservoir releases will be initiated as Round Valley Reservoir nears its minimum elevation to avoid a drop in canal flows when Round Valley Reservoir flows cease.

3. Philbrook Reservoir releases will initially be made at a steady rate of approximately 10 to 15 cfs until such time as an increase may be necessary to address an extreme heat event as provided in the 2005 Project Operations and Maintenance Plan. An extreme heat event is defined by air temperatures measured at Cohasset, California that are in excess of 105 °F for two or more days during a seven day period, with the potential for compression heating at higher elevations as confirmed by air temperature data from Chester, California.

4. In the event an extreme heat event is forecast and is expected to continue for over two days, PG&E will confer with the resource agencies. If deemed appropriate, and if releases are being made from Round Valley Reservoir, then releases from Round Valley Reservoir will be reduced by approximately 50 percent and the

release valve at cooler Philbrook Reservoir will be opened to provide a total release of up to 35 cfs.

5. Flows below LCDD will be increased after mid-September to further enhance conditions for CV spring-run Chinook salmon spawning in the anadromous waters of Butte Creek.

C. Project Maintenance

Routine project maintenance activities include road maintenance work, herbicide application on canals, instream maintenance work, forebay dredging, and canal and powerhouse outages. In the 2005 and 2006 Project Operations and Maintenance Plans, PG&E identified several specific practices intended to minimize the effects of project maintenance on anadromous salmonids. These include taking scheduled canal outages as early as possible in the year, using conservative ramping rates to restore flows to Lower Centerville Canal after an outage or when the flow in the canal is increased, taking steps to minimize potential effects from unusual conditions such as winter storms, disruption of canal flows caused by slides or fallen trees, or unexpected electric transmission system outages.

After an outage, and consistent with the annual Project Operations and Maintenance Plan, PG&E consults with the resource agencies (i.e., NOAA, USFWS, USFS, CDFG, and SWRCB) and returns the water to the canals in a manner that minimizes turbidity and the transport of material to surface waters. PG&E monitors water quality (grab samples tested for turbidity and settleable solids) hourly for a period of up to four hours. For the start-up of Centerville Powerhouse, the monitoring location is at the bridge downstream of Centerville Powerhouse; for the start-up of DeSabla Powerhouse, the monitoring location is LCDD.

In addition to the maintenance practices described in the 2005 Project Operations and Maintenance Plan, PG&E has adopted other measures to avoid or minimize the potential effect of maintenance practices on the CV spring-run Chinook salmon and their habitat. For example, formal spill prevention control and countermeasure plans have been developed for all project facilities. Project road maintenance practices are designed to minimize erosion that could contribute sediment to streams in the action area. During the winter, culverts are routinely inspected and cleaned if necessary to prevent clogging that could cause overtopping and washouts. In the spring, after the danger of significant storms has passed, crews conduct other needed road maintenance; all grading is confined to the existing road footprint. Where appropriate, road outslopes are maintained to disperse runoff, and existing gutters and culverts are cleaned and maintained.

PG&E also intermittently applies herbicides adjacent to Butte, Hendricks/Toadtown, and Lower Centerville canals for weed control. PG&E carefully administers these applications so that no herbicide is sprayed directly into the water or on a surface that can come into contact with water. Herbicides approved for aquatic use (*i.e.*, Karmex and Direx), may be applied along the bank side of a canal during an outage to control plant growth near the water line. All herbicides are applied only by licensed, qualified herbicide applicators. Beginning in 2006, PG&E voluntarily will no longer apply any herbicides containing chemicals identified in 3 CCR 6800(a), the California Restricted Material List, because the have been found to affect ground water. Currently, both Karmex and Direx are on the list.

D. Water Diversions for Consumptive Use Related to Project

PG&E's rights to divert and use water for operation of the project are primarily non-consumptive in nature. PG&E holds all water rights necessary to fully operate the project. Some of these rights date back to as early as 1858. Although PG&E has no public utility obligation to deliver water for consumptive uses, project features are at times used for this purpose. Currently, the Del Oro Water Company (Del Oro) provides water service to customers in the Stirling City area using up to 100 acre-feet of water per year obtained from the Hendricks Canal. The rights to this water were obtained by Del Oro from an original 365 acre-feet allocation that once belonged to Diamond Match. Diamond Match had used the water for its mill in Stirling City and also to provide domestic water service to the area. The remaining 265 acre-feet were purchased by PG&E with the condition that Del Oro could retain the right to purchase this amount annually, upon request, provided the water was available. Water delivered under this arrangement is conveyed through an existing slide gate on the Toadtown Canal at a location approximately 1,440 feet downstream of Toadtown Powerhouse, which releases into Little Butte Creek.

Minor consumptive uses have historically occurred along the Upper Centerville Canal and a flow of approximately 2 cfs is maintained in the canal for such uses. Additional water deliveries are made at the Toadtown header box to Eldon Duinsing and on the Lower Centerville Canal near Helltown to Allen Harthorn.

In addition to the deliveries discussed above, PG&E makes deliveries of water to the California Water Service Company (CWSC) and to PG&E customers downstream of the Hendricks Head Dam. These deliveries are made at the end of PG&E's small Miocene system which discharges into CWSC's Powers Canal. CWSC uses these deliveries to serve irrigation customers and the City of Oroville. The current minimum instream flow release at Hendricks Head Dam plus accretion flows to the WBFR, typically provide an adequate supply of water to meet CWSC's needs.

E. Proposed Conservation Measures

In addition to the measures incorporated into the proposed project to address the needs of CV spring-run Chinook salmon and their designated critical habitat, PG&E proposes to undertake a number of studies during the upcoming relicensing of the project. Some of the more significant studies are summarized below.

1. <u>Water Temperature Monitoring and Modeling</u>

The relationship between streamflow and water temperature in the project-affected stream reaches has received considerable attention for many years. In particular, the annual Project Operations and Maintenance Plans are a coordinated effort by PG&E, NMFS, CDFG, and USFWS to manage stream water temperature in Butte Creek during the summer through changes in project operations (*i.e.*, timing and magnitude of water releases from project reservoirs) for the protection of CV spring-run Chinook salmon. PG&E currently is conducting a licensing study to develop a predictive stream temperature model to assist in the evaluation of the effectiveness of controlling Butte Creek stream temperatures through changes in project operations. The objective of the proposed study is to develop a model that can be used to evaluate the range of operational alternatives for controlling summer (*i.e.*, June through September) stream temperatures in Butte Creek between the DeSabla Powerhouse and just downstream of Centerville Powerhouse.

The proposed study area for the water temperature modeling includes Round Valley and Philbrook Reservoirs and the stream channels from each reservoir to Hendricks Diversion Dam on WBFR, the Hendricks and Toadtown canals; the combined Butte Creek and Toadtown canals into DeSabla Forebay; DeSabla Forebay itself; and Butte Creek, including Lower Centerville Canal, from DeSabla Powerhouse to just downstream from the Centerville Powerhouse, below the confluence of Butte Creek and the Centerville Powerhouse tailrace waters. This study area encompasses the project structures (*i.e.*, reservoirs, canals, forebays, and powerhouses) that are operated to control temperatures in Butte Creek for the benefit of CV spring-run Chinook salmon. The study will also include water temperature, streamflow, and meteorological monitoring at selected locations on WBFR, above Hendricks Diversion Dam; and Butte Creek, from DeSabla Powerhouse to Centerville Powerhouse. This monitoring will be used in developing, calibrating, and utilizing the water temperature model.

2. <u>Survey Spring-run Chinook Salmon Pre-Spawning Mortality and Spawning Escapement</u>

CDFG is currently conducting spawning escapement surveys as part of an ongoing monitoring program. Since 2002, PG&E has funded CDFG to conduct weekly surveys to evaluate CV spring-run Chinook salmon pre-spawning mortality in Butte Creek. Survey methods are described in Ward *et al.* (2004). PG&E intends to continue to fund CDFG pre-spawning mortality surveys to provide additional information on the relationship between pre-spawning mortality, weather patterns, and project operations. The pre-spawning mortality surveys will be continued until the factors affecting these events are more clearly understood.

3. <u>Instream Flow Studies on Butte Creek</u>

This study will involve conducting habitat mapping and new instream flow studies for the two anadromous reaches below LCDD and Centerville Powerhouse. The results of the habitat mapping will provide the baseline information for selecting study sites and transects to be used in the Physical Habitat Simulation (PHABSIM) models.

Representative instream flow transects will be selected in consultation with the resource agencies based on habitat mapping to permit modeling of habitat for CV spring-run

Chinook salmon yearlings, CV steelhead juveniles, and rainbow trout juveniles, adults, and spawning. PG&E proposes a data collection effort for Central Valley late-fall run Chinook salmon (*O. tshawytscha*) and CV steelhead spawning. Both species are expected to spawn in Butte Creek between December and February, when high and unregulated flows dominate the system. Although high flow conditions and the potentially small number of spawners likely will preclude typical habitat suitability curve development, an effort will be made to document the presence, location, and associated habitat conditions for any redds. Flow-habitat relationships will be modeled using a 1-dimensional approach, with results for the stream reaches expanded based on habitat mapping.

The results of these instream flow studies, in combination with the water temperature model and other resource studies will provide a basis for streamflow-related resource management decisions. PG&E will compile existing habitat suitability curve data in collaboration with the resource agencies to create a database of curves that can be reviewed for applicability to the project. PG&E anticipates that criteria will be needed for yearling Chinook salmon. Site-specific curves for spawning CV spring-run Chinook salmon are already available from a USFWS study on Butte Creek.

F. Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). The action area for the purposes of this biological opinion includes geographic areas and project facilities that are both within and outside of anadromous watersheds. The action area covers a portion of two drainage basins, Butte Creek and the WBFR. The Butte Creek basin drains into the Sacramento River near Colusa, and ranges in elevation from 7,100 feet to 475 feet at Centerville Powerhouse. The action area does not include any stream or river reaches in the Feather River, downstream of the Hendricks Diversion Dam, because historic anadromous habitat in the WBFR has been permanently blocked by the presence of the 770 foot-tall Oroville Dam on the Feather River, near the City of Oroville, California. NMFS also assumes that the small diversion from the WBFR does not have a significant influence on the storage of water in Oroville Reservoir (*i.e.*, 3,537,580 acre-feet), and does not result in flow or temperature-related effects to Federally listed salmonids in the Feather River, downstream from Oroville Dam.

The following area was selected because it represents the geographic distribution of project-related facilities in the WBFR and Butte Creek drainage basins, and the area of anadromous habitat in Butte Creek downstream to a point where the project's effects on CV spring-run Chinook salmon are expected to be negligible:

1. All project-affected reaches in the non-anadromous WBFR drainage basin including:

    a. The headwaters of the WBFR, and all project-affected reaches from Round Valley Reservoir down to the Hendricks Diversion Dam. Flows below Hendricks Diversion Dam enter Oroville Dam, and are not expected to affect anadromous fish. Therefore stream reaches below the dam are not within the action area.

b. Philbrook Creek from Philbrook Reservoir downstream to the WBFR.

c. Long Ravine, Cunningham Ravine, the little West Fork downstream of the Hendricks Canal, and project facilities including the Hendricks Canal, Toadtown Canal, Toadtown Powerhouse, Butte Canal, DeSabla Forebay, DeSabla Powerhouse, Lower Centerville Canal, and Centerville Powerhouse.

2. All project-affected reaches in the anadromous Butte Creek drainage basin including:

   a. The non-anadromous reach from the Butte Diversion Dam downstream to the Centerville Diversion Dam, Inskip, Kelsey, and Clear Creeks between Butte Canal and their confluence with Butte Creek.

   b. The anadromous reach of the Butte Creek from the Centerville Diversion Dam downstream to the Parrot-Phelan Diversion Dam. Parrot-Phelan Dam represents the downstream point in which project operations are expected to affect water temperature and anadromous fish.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

This preliminary biological opinion analyzes the effects of proposed action on the following threatened and endangered species and designated and proposed critical habitat:

Central Valley spring-run Chinook salmon - threatened
Central Valley spring-run Chinook salmon - designated critical habitat

Although portions of the action area are occupied by CV steelhead and are designated critical habitat for this species, at the request of FERC and PG&E, this early consultation only addresses potential impacts to CV spring-run Chinook salmon and their designated critical habitat. Potential effects of the project on CV steelhead and their designated critical habitat will be analyzed in a final biological opinion prior to FERC issuing a new license for the project in 2009.

A. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

NMFS listed the CV spring-run Chinook salmon ESU as threatened on September 16, 1999 (64 FR 50394). In June 2004, NMFS proposed that CV spring-run Chinook salmon remain listed as threatened (69 FR 33102). This proposal was based on the recognition that although CV spring-run Chinook salmon productivity trends are positive, the ESU continues to face risks from having a limited number of remaining populations (*i.e.*, 3 existing populations from an estimated 17 historical populations), a limited geographic distribution, and potential hybridization with Feather River Hatchery (FRH) spring-run Chinook salmon, which until recently were not included in the ESU and are genetically divergent from other populations in Mill, Deer, and Butte Creeks. On June 28, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of CV spring-run Chinook salmon as threatened (70 FR 37160). This decision also included the FRH spring-run Chinook salmon population as part of the CV spring-run Chinook salmon ESU.

The decision to include the FRH population was based on several factors: (1) FRH spring-run Chinook salmon are no more divergent from the naturally spawning population in the Feather River than would be expected between two closely related populations in the ESU; (2) NMFS believes the early run timing of spring-run Chinook salmon in the Feather River represents the evolutionary legacy of the populations that once spawned above Oroville Dam, and that the extant population in the Feather River may be the only remaining representative of this ESU component; (3) the California Department of Water Resources (CDWR) is planning to construct a weir to create geographic isolation for spring-run Chinook in the Feather River to minimize future hybridization with fall-run Chinook salmon, and to preserve the early run timing phenotype, and (4) the FHR spring-run Chinook salmon may play an important role in the recovery of spring-run Chinook salmon populations in the Feather and Yuba Rivers.

Historically, spring-run Chinook salmon were the dominant run in the Sacramento River basin, occupying the middle and upper elevation reaches (1,000 to 6,000 feet) of most streams and rivers with sufficient habitat for over-summering adults (Clark 1929). Clark estimated that there were 6,000 miles of salmon habitat in the Central Valley basin (much of which was high elevation spring-run Chinook salmon habitat) and that by 1928, 80 percent of this habitat had been lost. Yoshiyama *et al.* (1996) determined that, historically, there were approximately 2,000 miles of salmon habitat available prior to dam construction and mining and that only 18 percent of that habitat remains.

Adult CV spring-run Chinook salmon enter the Sacramento-San Joaquin Delta (Delta) from the Pacific Ocean beginning in January and enter natal streams from March to July. In Mill Creek, Van Woert (1964) noted that of 18,290 CV spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30.

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows also are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 °F to 56 °F (Bell 1991, CDFG 1998).

Upon entering fresh water, spring-run Chinook salmon are sexually immature and must hold in cold water for several months to mature. Typically, spring-run Chinook salmon utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering. Spring-run Chinook salmon also may utilize tailwaters below dams if cold-water releases provide suitable habitat conditions. Spawning occurs between September and October and, depending on water temperature, emergence occurs between November and February.

CV spring-run Chinook salmon emigration is highly variable (CDFG 1998). Some juveniles may begin outmigrating soon after emergence, whereas others oversummer and emigrate as yearlings with the onset of increased fall storms (CDFG 1998). The emigration period for CV spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year outmigrants passing through the lower Sacramento River between mid-November and early January (Snider and Titus 2000). Outmigrants also are known to rear in non-natal tributaries to the Sacramento River and the Delta (CDFG 1998).

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998). Fisher (1994) reported that 87 percent of Chinook salmon trapped and examined at RBDD between 1985 and 1991 were three-year olds.

Spring-run Chinook salmon were once the most abundant run of salmon in the Central Valley (Campbell and Moyle 1992) and were found in both the Sacramento and San Joaquin drainages. More than 500,000 CV spring-run Chinook salmon were caught in the Sacramento-San Joaquin commercial fishery in 1883 alone (Yoshiyama *et al.* 1998). The San Joaquin populations were essentially extirpated by the 1940s, with only small remnants of the run that persisted through the 1950s in the Merced River (Hallock and Van Woert 1959, Yoshiyama *et al.* 1998). Populations in the upper Sacramento, Feather, and Yuba Rivers were eliminated with the construction of major dams during the1950s and 1960s. Naturally spawning populations of CV spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Mill Creek, Feather River, and the Yuba River (CDFG 1998).

The CV spring-run Chinook salmon ESU has displayed broad fluctuations in adult abundance, ranging from 1,403 in 1993 to 25,890 in 1982 (Table 1). The average abundance for the ESU was 12,590 for the period of 1969 to 1979, 13,334 for the period of 1980 to 1990, 6,554 from 1991 to 2001, and 16,349 since 2002. Sacramento River tributary populations in Mill, Deer, and Butte Creeks are probably the best trend indicators for the Central Valley spring-run Chinook ESU as a whole because these streams contain the primary independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991 (Figure 1). Escapement numbers are dominated by Butte Creek returns, which have averaged over 7,000 fish since 1995. During this same period, adult returns on Mill Creek have averaged 778 fish, and 1,463 fish on Deer Creek. Although recent trends are positive, annual abundance estimates display a high level of fluctuation, and the overall number of Central Valley spring-run Chinook salmon remains well below estimates of historic abundance. Additionally, in 2003, high water temperatures, high fish densities, and an outbreak of Columnaris Disease (*Flexibacter Columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis*) contributed to the pre-spawning mortality of an estimated 11,231 adult spring-run Chinook salmon in Butte Creek.

Table 1. Adult spring-run Chinook salmon abundance indexes for Mill, Deer, and Butte Creeks since 1991.

Year	Central Valley Total	Mill	Deer	Butte
1991	5,926	319	479	-
1992	3,044	237	209	730
1993	6,075	61	259	650
1994	6,187	723	485	474
1995	15,238	320	1,295	7,500
1996	9,082	253	614	1,413
1997	8,448	200	466	635
1998	31,471	424	1,879	20,259
1999	10,603	560	1,591	3,679
2000	9,429	544	637	4,118
2001	15,794	1,104	1,622	9,605
2002	17,407	1,594	2,185	8785
2003	17,564	1,426	2,759	4398
2004	14,074	988	804	7,394
2005	not available	1,150	2,239	10,625

Overall, the Central Valley spring-run Chinook salmon ESU is at relatively high risk of extinction because there are only three existing independent populations, and the three populations are all relatively close together, making them vulnerable to catastrophes such wildfire, volcanic activity, or a prolonged regional drought (Lindley *et al.* 2006).

B. Critical Habitat Condition and Function for Species' Conservation

Critical Habitat for CV spring-run Chinook salmon was designated on September 2, 2005 (70 FR 52488). Critical habitat includes stream channels within certain occupied stream reaches and includes a lateral extent as defined by the ordinary high water mark (33 CFR 329.11) or the bankfull elevation. Critical habitat in estuarine reaches is defined by the perimeter of the water body or the elevation of the extreme high water mark, whichever is greater. The designation identifies primary constituent elements that include sites necessary to support one or more life stages and, in turn, these sites contain the physical or biological features essential for conservation of the ESU. Specific sites include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine rearing areas. The physical or biological features that characterize these sites include water quality, quantity, depth, and velocity, shelter/cover, living space, and passage conditions.

The freshwater habitat of salmon in the Central Valley varies in function depending on location. Spawning areas are located in accessible, upstream reaches of the Sacramento River and its' tributaries where viable spawning gravels and water conditions are found. Spawning habitat condition is strongly affected by water flow and quality, especially temperature, dissolved oxygen, and silt load, all of which can greatly affect the survival of eggs and larvae.

Migratory corridors are downstream of the spawning area and include the Delta. These corridors allow the upstream passage of adults, and the downstream emigration of outmigrant juveniles. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams, unscreened or poorly screened diversions, and degraded water quality.

Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River and Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]). However, the channelized, leveed, and rip-rapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators.

C. Factors Affecting the Species and Critical Habitat

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon in the Central Valley. For example, NMFS prepared range-wide status reviews for west coast Chinook salmon (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996). Also, the NMFS BRT published updated status review for west coast Chinook salmon and steelhead in June 2003 (NMFS 2003). Information also is available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (*e.g.*, 58 FR 33212; 59 FR 440; 62 FR 24588; 62 FR 43937; 63 FR 13347; 64 FR 24049; 64 FR 50394; 65 FR 7764). The Final Programmatic Environmental Impact Statement/Report (EIS/EIR) for the CALFED Bay-Delta Program (CALFED 1999) and the Department of the Interior's (DOI) Final Programmatic EIS for the Central Valley Project Improvement Act (CVPIA) (DOI 1999) provide summaries of historical and recent environmental conditions for salmon in the Central Valley. The following general description of the factors affecting the viability of CV spring-run Chinook salmon is based on a summary of these documents.

In general, the human activities that have affected the listed anadromous salmonids and their habitats addressed in this opinion consist of: (1) dam construction that blocks previously accessible habitat; (2) water development and management activities that affect water quantity, flow timing, and quality; (3) land use activities such as agriculture, flood control, urban development, mining, road construction, and logging that degrade aquatic and riparian habitat; 4) hatchery operation and practices; (5) harvest activities; (6) predation; and (7) ecosystem restoration actions.

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the CVP, State Water Project (SWP), and other municipal and private entities have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and the Delta block salmon access to the upper portions of the respective watersheds. On the Sacramento River, Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud, and Pit Rivers. Whiskeytown Dam blocks access to the upper watershed of Clear Creek. Oroville Dam and associated facilities block passage to the upper Feather River watershed. Nimbus Dam blocks access to most of the American River basin. Friant Dam construction in the mid-1940s has been associated with the elimination of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River (DOI 1999). On the Stanislaus River, construction of New Melones Dam and Goodwin Dam blocked both spring and fall-run Chinook salmon.

As a result of the dams, CV Chinook salmon populations on these rivers have been confined to lower elevation mainstems that historically only were used for migration, or have disappeared. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. Higher temperatures at these lower elevations during late-summer and fall are a major stressor to adults and juvenile salmonids.

The Suisun Marsh Salinity Control Gates (SMSCG), located on Montezuma Slough, were installed in 1988, and are operated with gates and flashboards to decrease the salinity levels of managed wetlands in Suisun Marsh. The SMSCG have delayed or blocked passage of adult Chinook salmon migrating upstream (Edwards *et al.* 1996, Tillman *et al.* 1996).

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted stream flows and altered the natural cycles by which juvenile and adult salmonids base their migrations. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased recruitment of gravel and large woody debris (LWD). Furthermore, more uniform year-round flows have resulted in diminished natural channel formation, altered foodweb processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Ayers 2001) and caused spawning gravels to become embedded and reduced channel width, which has decreased the available spawning and rearing habitat below dams.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, and their tributaries. Although efforts have been made in recent years to screen some of these diversions, many remain unscreened. Depending on the size, location, and season of operation, these unscreened intakes entrain and kill many life stages of aquatic species, including juvenile salmonids. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (USFWS 2003).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmonid survival has been reduced from: (1) water diversion from the mainstem Sacramento River into the Central Delta via the Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay; and (4) increased exposure to introduced, non-native predators such as striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), and American shad (*Alosa sapidissima*).

The consultation for the CVP operations, criteria, and plan (OCAP) was completed with the issuance of a biological opinion by NMFS on October 22, 2004. The OCAP biological opinion found that CVP and SWP actions are likely to adversely affect Federally listed CV spring-run Chinook salmon, and other listed salmonids due to reservoir releases, Sacramento River flows, water temperatures, and physical facility operations that reduce habitat availability and suitability. These effects are expected to impact and result in the take of individual fish by delaying or blocking adult migration into suitable spawning habitat and decreasing spawning success, killing vulnerable life stages such as eggs, larvae, and juveniles due to stranding or elevated water temperatures, or increasing the likelihood of disease or juvenile vulnerability to predation due to temperature stress. NMFS determined that these effects are not likely to jeopardize the continued existence of CV spring-run Chinook salmon, and are not likely to destroy or adversely modify their designated critical habitat.

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for four or five miles (California Resources Agency 1989). By 1979, riparian habitat along the Sacramento River had diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The degradation and fragmentation of riparian habitat had resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture (Jones and Stokes Associates, Incorporated 1993). Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation (NMFS 1996). Sedimentation can adversely affect salmonids during all freshwater life stages by; clogging, or abrading gill surfaces, adhering to eggs, and restricting fry emergence (Phillips and Campbell 1961); burying eggs or alevins; scouring and filling in pools and riffles; reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961); and affecting intergravel permeability and dissolved oxygen levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning, and egg and fry survival (Hartmann *et al.* 1987).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation resulting in increased streambank erosion (Meehan and Bjornn 1991). Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NMFS 1998). LWD influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979, Bilby 1984, Robison and Beschta 1990).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Goals Project 1999). In Suisun Marsh, salt water intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by CDWR on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and an increase in the clarity of the water. These conditions likely have contributed to increased mortality of juvenile Chinook salmon as they move through the Delta.

4. Hatchery Operations and Practices

Five hatcheries currently produce Chinook salmon in the Central Valley. Releasing large numbers of hatchery fish can pose a threat to wild Chinook salmon through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (DOI 1999).

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring- and fall-run fish have led to the hybridization and homogenization of some subpopulations (CDFG 1998). As early as the 1960s, Slater (1963) observed that early fall- and spring-run Chinook salmon were competing for spawning sites in the Sacramento River below Keswick Dam, and speculated that the two runs may have hybridized. FRH spring-run Chinook salmon have been documented as straying throughout the Central Valley for many years (CDFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon (Colleen Harvey-Arrison and Paul Ward, CDFG, pers. comm., 2002), an indication that FRH spring-run Chinook salmon may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and counted at RBDD contain hybridized fish.

The management of hatcheries, such as Nimbus Hatchery and FRH, can directly impact CV spring-run Chinook salmon populations by overproducing the natural capacity of the limited habitat available below dams. In the case of the Feather River, significant redd superimposition occurs in-river due to hatchery overproduction and the inability to physically separate CV spring-run and fall-run Chinook salmon adults. This concurrent spawning has led to hybridization between the spring- and fall-run Chinook salmon in the Feather River.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where regulations are set according to hatchery population. This can lead to over-exploitation and reduction in size of wild populations coexisting in the same system (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown effective in bolstering the numbers of naturally spawning fish in the short term under certain conditions, and in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels, such as Sacramento River winter-run Chinook salmon (*O. tshawytscha*). However, relative abundance is only one component of a viable salmonid population (McElhany, *et al.* 2000).

5. Ocean and Sport Harvest

Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon. Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement. CWT returns indicate that Sacramento River salmon congregate off the coast between Point Arena and Morro Bay.

Historically in California, almost half of the river sportfishing effort was in the Sacramento-San Joaquin River system, particularly upstream from the city of Sacramento (Emmett *et al.* 1991). Since 1987, the Fish and Game Commission has adopted increasingly stringent regulations to reduce and virtually eliminate the in-river sport fishery for winter-run Chinook salmon. Present regulations include a year-round closure to Chinook salmon fishing between Keswick Dam and the Deschutes Road Bridge and a rolling closure to Chinook salmon fishing on the Sacramento River between the Deschutes River Bridge and the Carquinez Bridge. The rolling closure spans the months that migrating adult winter-run Chinook salmon are ascending the Sacramento River to their spawning grounds. These closures have virtually eliminated impacts on winter-run Chinook salmon caused by recreational angling in freshwater. In 1992, the California Fish and Game Commission adopted gear restrictions (all hooks must be barbless and a maximum of 5.7 cm in length) to minimize hooking injury and mortality of winter-run Chinook salmon caused by trout anglers.

In-river recreational fisheries historically have taken CV spring-run Chinook salmon throughout the species' range. During the summer, holding adult CV spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of CV spring-run Chinook salmon in Mill, Deer, Butte and Big Chico Creeks were added to the existing CDFG regulations in 1994. The current regulations, including those developed for winter-run Chinook salmon, provide some level of protection for CV spring-run Chinook salmon (CDFG 1998).

6. Predation

Accelerated predation also may be a factor in the decline CV spring-run Chinook salmon. Additionally, human-induced habitat changes such alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators (Stevens 1961, Decato 1978, Vogel *et al.* 1988, Garcia 1989).

On the mainstem Sacramento River, high rates of predation are known to occur at RBDD, Anderson Cottonwood Irrigation District, and Glenn Colusa Irrigation District, areas where rock revetment has replaced natural river bank vegetation, and at south Delta water diversion structures (*e.g.*, Clifton Court Forebay; CDFG 1998). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly susceptible to predation by fish or birds. Sacramento pikeminnow (*Ptychocheilus grandis*) and striped bass congregate below the dam and prey on juvenile salmon.

USFWS found that more predatory fish were found at rock revetment bank protection sites between Chico Landing and Red Bluff than at sites with naturally eroding banks (Michny and Hampton 1984). From October 1976 to November 1993, CDFG conducted 10 mark/recapture experiments at the SWP's Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile Chinook salmon. Pre-screen losses ranged from 69 percent to 99 percent. Predation from striped bass is thought to be the primary cause of the loss (Gingras 1997).

Other locations in the Central Valley where predation is of concern include flood bypasses, release sites for salmonids salvaged at the State and Federal fish facilities, and the SMSCG. Predation on salmon by striped bass and pikeminnow at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967; Pickard *et al.* 1982). Predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987-1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the structure was striped bass, and juvenile Chinook salmon were identified in their stomach contents (NMFS 1997).

7. Ecosystem Restoration

a. *CALFED*

Two programs under CALFED, the ERP and the Environmental Water Account (EWA), were created to improve conditions for fish, including listed salmonids, in the Central Valley. Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these recent actions address key factors affecting listed salmonids, and emphasis has been placed in tributary drainages with high potential for CV spring-run Chinook salmon production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat restoration initiatives sponsored and funded primarily by the CALFED-ERP program have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids. Similar habitat restoration is imminent adjacent to Suisun Marsh (*i.e.*, at the confluence of

Montezuma Slough and the Sacramento River) as part of the Montezuma Wetlands project, which is intended to provide for commercial disposal of material dredged from San Francisco Bay in conjunction with tidal wetland restoration.

b. *CVPIA*

The CVPIA implemented in 1992 requires that fish and wildlife get equal consideration with water allocations from the CVP. From this act arose two programs that benefit listed salmonids: the Anadromous Fish Restoration Program (AFRP) and the Water Acquisition Program (WAP). The AFRP has engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for CV spring-run Chinook salmon by maintaining or increasing instream flows in Butte and Mill Creeks at critical times.

c. *Iron Mountain Mine Remediation*

The Environmental Protection Agency's (EPA) Iron Mountain Mine remediation involves the removal of toxic metals in acidic mine drainage from the Spring Creek Watershed with a state-of-the-art lime neutralization plant. Contaminant loading into the Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990s. Decreasing the heavy metal contaminants that enter the Sacramento River should increase the survival of salmonid eggs and juveniles. However, during periods of heavy rainfall upstream of the Iron Mountain Mine, FERC substantially increases Sacramento River flows in order to dilute heavy metal contaminants being spilled from Spring Creek debris dam. This rapid change in flows can cause juvenile salmonids to become stranded or isolated in side channels below Keswick Dam.

d. *SWP Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

The Four Pumps Agreement Program has approved about $49 million for projects that benefit salmon production in the Sacramento-San Joaquin basins and Delta since the agreement inception in 1986. Four Pumps projects that benefit CV spring-run Chinook salmon and include water exchange programs on Mill and Deer Creeks; enhanced law enforcement efforts from San Francisco Bay upstream to the Sacramento and San Joaquin Rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and screening of diversions in Suisun Marsh and San Joaquin tributaries.

The Spring-run Salmon Increased Protection project provides overtime wages for CDFG wardens to focus on reducing illegal take and illegal water diversions on upper Sacramento River tributaries and adult holding areas, where the fish are vulnerable to poaching. This project covers Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, and has been in effect since 1996. Through the Delta-Bay Enhanced Enforcement Program, initiated in 1994, a team of 10 wardens focus their enforcement efforts on salmon, and other species of concern from the San Francisco Bay Estuary upstream into the Sacramento and San Joaquin River basins. These two enhanced enforcement programs, in combination with additional concern and attention from local landowners and watershed groups on the Sacramento River tributaries which support CV spring-run Chinook salmon summer holding habitat, have been shown to reduce the amount of poaching in these upstream areas.

The provisions of funds to cover over-budget costs for the Durham Mutual/Parrot Phelan Screen and Ladders project expedited completion of the construction phase of this project which was completed during 1996. The project continues to benefit salmon by facilitating upstream passage of adult spawners and downstream passage of juveniles.

The Mill and Deer Creek Water Exchange projects are designed to provide new wells that enable diverters to bank groundwater in place of stream flow, thus leaving water in the stream during critical migration periods. On Mill Creek several agreements between Los Molinos Mutual Water Company (LMMWC), Orange Cove Irrigation District (OCID), CDFG, and CDWR allows CDWR to pump groundwater from two wells into the LMMWC canals to pay back LMMWC water rights for surface water released downstream for fish. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement was for a well capacity of 25 cfs, only 12 cfs has been developed to date (PG&E 2005). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult CV spring-run Chinook salmon in Mill Creek (PG&E 2005a). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult CV spring-run Chinook salmon and downstream migrating juveniles. However, the current arrangement does not ensure adequate flow conditions will be maintained in all years. CDWR, CDFG, and USFWS have developed the Mill Creek Adaptive Management Enhancement Plan to address the instream flow issues. A pilot project using one of the 10 pumps originally proposed for Deer Creek was tested in summer 2003. Future testing is planned with implementation to follow.

8. <u>Climate Change</u>

The world is about 1.3 °F warmer today than a century ago and the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees in the 21st century (IPCC 2001). Much of that increase will likely occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes 1998). Using objectively analyzed data Huang and Liu (2000) estimated a warming of about 0.9 °F per century in the Northern Pacific Ocean.

Sea levels are expected to rise by 0.5 to 1.0 meters in the northeastern Pacific coasts in the next century, mainly due to warmer ocean temperatures, which lead to thermal expansion much the same way that hot air expands. This will cause increased sedimentation, erosion, coastal flooding and permanent inundation of low-lying natural ecosystems (*e.g.*, salt marsh, riverine, mud flats) affecting salmonid PCEs.

Summer droughts along the South Coast and in the interior of the northwest Pacific coastlines will mean decreased stream flow in those areas, decreasing salmonid survival and reducing water supplies in the dry summer season when irrigation and domestic water use are greatest. Global warming may also change the chemical composition of the water that fish inhabit: the amount of oxygen in the water may decline, while pollution, acidity, and salinity levels may increase. This will allow for more invasive species to over take native fish species and impact predator-prey relationships (Stachowicz *et al.* 2002, Peterson and Kitchell 2001).

An alarming prediction, is the fact that Sierra snow packs are expected to decrease with global warming and that the majority of runoff in California will be from rainfall in the winter rather than from melting snow pack in the mountains. This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival in some Central Valley streams and rivers. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This should truncate the period of time that suitable cold-water conditions exist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids (*i.e.* Sacramento River winter-run Chinook salmon and CV steelhead) that must hold below the dam over the summer and fall periods.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the status of the species within the action area. The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR §402.02). For continuing actions which are already in place, (*i.e.*, relicensing a hydroelectric facility) NMFS first describes the existing condition including the impacts of the ongoing action from the initial construction and operation of the facility, up to the point of the consultation, and then projects the anticipated future base conditions that would exist assuming the continuing action will no longer be authorized, funded, or carried out. We then add the effects of the proposed action to the projected baseline to assess the likelihood of the project action jeopardizing the listed species or resulting in the destruction or adverse modification of critical habitat.

The action area includes the non-anadromous watershed of the WBFR, non-anadromous reaches of Butte Creek, from the Butte Diversion Dam downstream to the Centerville Diversion Dam, and anadromous reaches of Butte Creek from below the Centerville Diversion Dam downstream to Parrot-Phelan Diversion Dam. The entire reach downstream from Centerville Diversion Dam is occupied by CV spring-run Chinook salmon and is designated critical habitat. From Centerville Diversion Dam downstream to Parrot-Phelan Diversion Dam, Butte Creek is used by CV spring-run Chinook salmon for migration, adult holding and spawning, and juvenile rearing. Essential habitat elements in the action area are present for all freshwater life-history stages of CV spring-run Chinook salmon, including the temperatures, flows, and other physical habitat parameters necessary for adult upstream migration, adult holding and spawning, egg incubation, and juvenile rearing and emigration.

A. Status of the Species and Critical Habitat in the Action Area

Butte Creek contains the largest population of CV spring-run Chinook salmon in the ESU. Populations have increased substantially in the past 10 years. The quantity and quality of current habitat likely is much higher compared to historic conditions due to the import of cold water from the WBFR, and the transfer of water through certain canals. The CV spring-run Chinook salmon habitat in Butte Creek is unique because it is all below 930 feet. In nearby Mill and Deer Creeks, the majority of the holding and spawning habitat is at elevations between approximately 1800 and 4,000 feet. Due to the low elevation of the habitat in Butte Creek, water temperatures often exceed ideal levels for holding and spawning. In some years (*i.e.*, 2002 and 2003), these water temperatures combined with high fish densities have led to significant pre-spawning mortalities.

The CV spring-run Chinook salmon adult holding and spawning habitat in Butte Creek is approximately 11 to 12 miles long, extending from the Quartz Bowl Pool downstream the Centerville Covered Bridge. Some holding and spawning may occur below the Centerville Covered Bridge, as far downstream as the Parrot Phelan Dam. Flows in this 11- to 12-mile reach are controlled by PG&E for power generation at the DeSabla and Centerville powerhouses. The uppermost 3 miles below the Quartz Bowl Pool contains the highest number of deep holding pools, while the majority of spawning gravel is located in the 5 miles downstream from the Centerville Powerhouse.

1. <u>Status of CV spring-Run Chinook Salmon in Butte Creek</u>

a. *Relation of Butte Creek spring-run Chinook salmon to other population groups of CV spring-run Chinook salmon*

CV spring-run Chinook salmon in Butte Creek appear to have the most distinct genotype among the Central Valley ESU populations (Lindley *et al.* 2004). Based on historical distributional information, geography, hydrography, ecology, population genetics, life history information, and trends in abundance, Lindley *et al.* (2004) concluded that Butte Creek spring-run Chinook salmon are unique, and are genetically distinct from other Chinook salmon populations, including Sacramento River winter-run Chinook salmon (*O. tshawytscha*), and Central Valley fall/late fall-run Chinook salmon (*O. tshawytscha*). Butte Creek. Results of genetic studies by Banks *et al.* (2000), Hedgecock (2002), Kim *et al.* (1999), and Teel (unpublished, as cited in Lindley *et al.* 2004), found Butte Creek spring-run Chinook salmon to be distinct from other spring-run Chinook salmon in Mill and Deer Creeks, the Feather River, and other Chinook salmon groupings in the Central Valley. Based on these factors, and the geographic proximity of Butte Creek in comparison to Deer and Mill Creeks, Lindley *et al.* (2004) determined that Butte Creek spring-run Chinook salmon represent an independent population within the ESU.

The relation of Butte Creek spring-run Chinook salmon to Feather River spring-run Chinook salmon has been questioned because CDFG stocked Feather River fry into Butte Creek several decades ago. Additionally, Butte Creek is the first major watershed to the north of the Feather River, and flows into the Feather River near the confluence with the Sacramento River, near Verona. Despite these circumstances, available genetics information (Banks *et al.* 2000, Hedgecock 2002, Kim *et al.* 1999, and Teel, unpublished, as cited in Lindley *et al.* 2004), and tag recovery data (Ward *et al.* 2003) suggest that Feather River spring-run have currently have little to no interaction with the Butte Creek population. This is further supported by the NMFS Technical Recovery Team (TRT) report assessing the viability of threatened and endangered and Chinook salmon in the Sacramento-San Joaquin basin (Lindley *et al.* 2006). In developing their framework for viability assessments, Lindley *et al.* used the best available scientific information available to show that the risk of hatchery population influences on Butte Creek spring-run Chinook salmon is low.

b. *Life History*

In Butte Creek, the CV spring-run Chinook salmon is one of three occurring runs; the fall and late-fall runs account for the two other runs. Within the Central Valley spring-run Chinook salmon ESU, the Butte Creek population generally is the most numerous (USFWS 1998).

Butte Creek spring-run Chinook salmon appear to have an earlier adult run timing than other spring-run Chinook salmon populations (Lindley *et* al. 2004). Adult CV spring-run Chinook salmon begin entering Butte Creek in late February. The last adults to reach Butte Creek generally arrive by mid-June (Ward and McReynolds 2004). CV spring-run Chinook salmon are geographically isolated from CV fall-run Chinook salmon at the Parrot Phelan Dam. The dam has a fish ladder and is not a complete barrier, but CDFG installs a fish exclusion device into the fish ladder between mid-September and early December to prevent CV fall-run Chinook from migrating upstream into habitat occupied by CV spring-run Chinook salmon. The phenology of CV spring-run Chinook in Butte Creek, including upstream migration, is shown in Figure 2.

Quartz Bowl Falls is generally considered to be the upstream limit to CV spring-run Chinook salmon (Hill and Webber 1999). In most years no fish ascend the falls. In some wet years a small percentage (*i.e.* less than 0.1 percent) of the adult population ascends Quartz Bowl Falls to hold in the reach downstream from the LCDD.

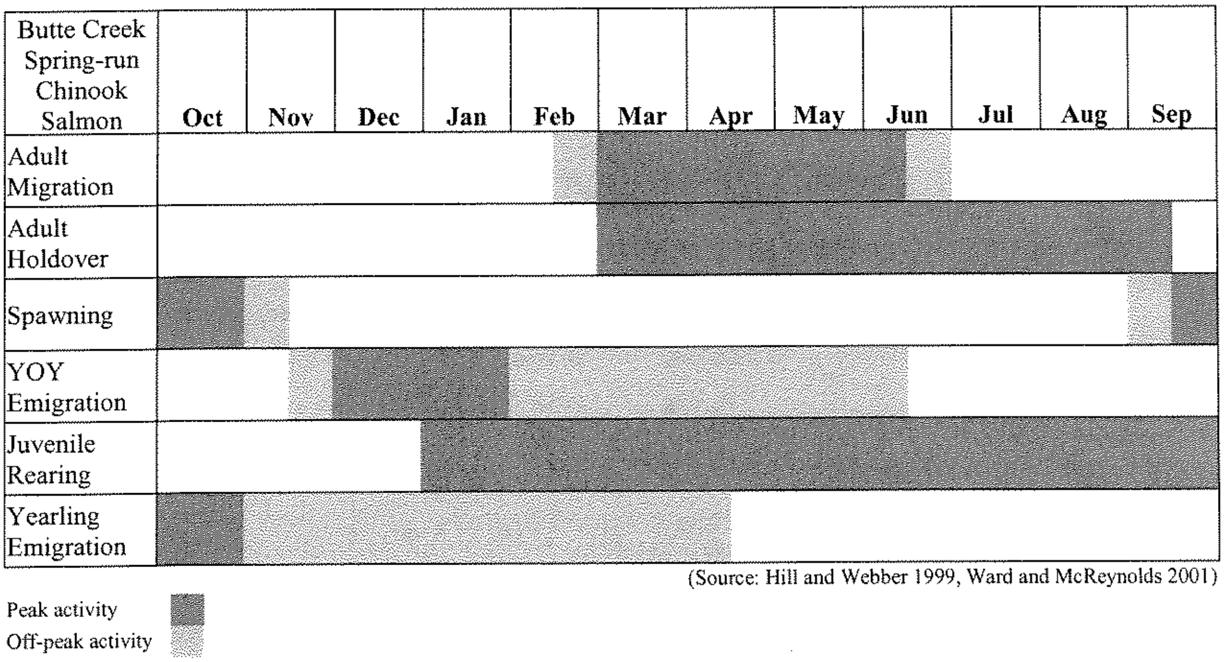

Figure 2. Phenology of CV spring-run Chinook salmon in Butte Creek.

Due to the low elevation of CV spring-run Chinook salmon habitat in Butte Creek, ambient stream temperatures often exceed the reported temperature tolerances of spring-run Chinook salmon (Ward and Keir 1999). Lindley *et al.* (2004) suggest, based on the ability of the Butte Creek population to regularly survive temperatures above the incipient lethal limit reported for spring-run Chinook salmon, that individuals may be more tolerant of warmer temperatures than most CV spring-run Chinook salmon stocks.

Spawning generally occurs from late August to mid-October. Once spawning is complete, the adult salmon die shortly thereafter. Historically, spawning Central Valley spring-run Chinook were mostly large four or five year old fish. Today, as Moyle (2002), Myers *et al.* (1998) and Fisher (1994) have found, three-year-old fish are the dominant age class. Moyle (2002) concluded that this shift in age of present-day spawners is the result of intensified commercial fishing that has had the effect of depleting stocks of the largest individuals. However, recent studies in Butte Creek suggest that, in at least some years, older fish may comprise the majority of returns. In 2003, CDFG estimated 69 percent of the 2003 adult population was over 4 years of age.

Embryos hatch following a 40 to 60-day incubation period at 5 to 13 °C; alevins (*i.e.*, sac-fry) remain in the gravel for another 4-6 weeks, until the yolk has been completely absorbed. In Butte Creek, the young fry generally remain in the gravel until their yolk sac is completely absorbed (*i.e.*, 4 to 6 weeks), although yolk sac fry have been captured at Parrott-Phelan Diversion Dam. Information collected by CDFG during the outmigration trapping at Parrott-Phelan Diversion Dam suggest eggs may remain in the gravel for up to 120 days or longer, depending on water temperature. Recently emerged fry identified as spring-run are regularly observed at Parrott-Phelan Diversion Dam in late-March.

Newly emerged fry generally move downstream into low velocity, nearshore habitats with abundant cover and food. In Butte Creek, the fry begin their downstream migration shortly after emerging from the gravel. Their downstream migration usually begins in mid-November and peaks between December and April (Hill and Webber 1999; Ward and McReynolds 2004). For the periods of 1995 to 1998, and 1998 to 2000, 98.2 percent and 96.3 percent, respectively, of all YOY spring-run Chinook migrated between December 1 and January 31. Greater than 99 percent of the out-migrating Chinook collected by CDFG are young-of-the-year (YOY) (Ward and McReynolds 2004, Ward *et al.* 2004a and 2004b). The average length of fry is 36 mm fork length (Hill and Webber 1999; Ward and McReynolds 2004). A lesser number of fry migrated in late-spring or early-summer.

The fry rear for a period of time before beginning their migration to the ocean. The Sutter Bypass, located approximately 55 miles downstream of Centerville Powerhouse, serves as a major nursery to the migrating Butte Creek spring-run Chinook fry (Hill and Webber 1999). Outmigrants have also been known to rear in non-natal tributaries to the Sacramento River, and the Sacramento-San Joaquin Delta (CDFG 1998). As juvenile fish grow, they move into faster, deeper water. A small number of Butte Creek spring-run Chinook salmon migrate as yearling fish (*i.e.*, age 1+) during the following fall and winter. Most yearling spring-run Chinook salmon migrate in October, but a few may migrate as late as April (Ward and McReynolds 2004).

c. *Population Dynamics*

Butte, Deer, and Mill Creeks support the majority of self-sustaining CV spring-run Chinook. Of these three, Butte Creek supports the largest population. Between 1995 and 2002, Butte Creek supported an average of 70 percent (*i.e.*, low = 45 percent; high = 89 percent) of the total Central Valley spring-run Chinook salmon population (CDFG).

The spring-run Chinook salmon population in Butte Creek has been monitored since 1954. Prior to 1993, a variety of methods of were used to estimate escapement. Since then, improved estimates have been achieved by using systematic snorkel counts of the entire adult holding habitat. During a 10-year period from 1956 through 1965, the annual spring-run escapement estimated by CDFG (2003) averaged about 2,800 fish, with an estimated high of 8,700 fish in 1960. During the next three decades, 1966-1975, 1976-1985, and 1986-1995, annual spring-run escapement estimated by CDFG (1998) averaged approximately 337, 162, and 1,354, respectively (Table 2). An alternate estimate recently has been developed using mark and recapture carcass counts and the

Schaefer Model (Schaefer 1951). The Schaefer estimate suggests that snorkel surveys significantly underestimate the actual population, sometimes by as much as 50 percent.

Table 2. Butte Creek Spring-run Chinook Salmon Snorkel Survey Results and Population Estimates, 1954 to 2004 (Ward *et al.* 2005).

YEAR	**RUN SIZE**	**YEAR**	**RUN SIZE**	**SCHAEFER ESTIMATE**	**PRE-SPAWN MORTALITIES**
1954	830	**1980**	226	NA	NA
1955	400	**1981**	250	NA	NA
1956	3,000	**1982**	534	NA	NA
1957	2,195	**1983**	50	NA	NA
1958	1,100	**1984**	23	NA	NA
1959	500	**1985**	254	NA	NA
1960	8,700	**1986**	1,371	NA	NA
1961	3,100	**1987**	14	NA	NA
1962	1,750	**1988**	1,300	NA	NA
1963	6,100	**1989**	1,300	NA	NA
1964	600	**1990**	100	NA	NA
1965	1,000	**1991**	100	NA	NA
1966	80	**1992**	730	NA	NA
1967	180	**1993**	650	NA	NA
1968	280	**1994**	474	NA	NA
1969	830	**1995**	7,500	NA	NA
1970	285	**1996**	1,413	NA	NA
1971	470	**1997**	625	NA	NA
1972	150	**1998**	20,212	NA	NA
1973	300	**1999**	3,679	NA	NA
1974	150	**2000**	4,118	NA	NA
1975	650	**2001**	9,605	18,312	193
1976	46	**2002**	8,785	12,897	3,431
1977	100	**2003**	4,398	6,063	11,231
1978	128	**2004**	7,390	10,219	418
1979	10	**2005**	10,625	NA	NA

3. Status of the Critical Habitat for CV Spring-Run Chinook Salmon in the Action Area

The action area is within designated critical habitat for CV spring-run Chinook salmon. The primary constituent elements of critical habitat within the action area are freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. The physical or biological features that characterize these sites include water quality, quantity, depth, and velocity, shelter/cover, living space, and passage conditions. The Critical Habitat Assessment Team Report (NMFS 2004) rated the conservation value of Butte Creek as high due to the presence of high quality holding and spawning habitat, the ability of the existing habitat to support a large population, and the success of recent and ongoing habitat restoration. The essential features of freshwater salmonid habitat within the action include: water temperatures, flows, and pool and riffle depths for adult upstream migration and summer holding; adequate substrate, flow and water temperatures for adult spawning; adequate substrate conditions, flows, and water temperatures for egg incubation, and emergence; and adequate water temperatures, flows, refugia and food production for juvenile rearing and emigrating juveniles.

CV spring-run Chinook salmon habitat located within the action area extends from Lower Centerville Diversion Dam, downstream to the Parrott-Phelan Diversion Dam. Along this length of Butte Creek, there are three major reaches that differ in character and fish use. Moving from upstream to downstream the first reach is located between LCDD and Quartz Bowl Falls. The second reach is located between Quartz Bowl Falls and the Centerville Powerhouse. The third reach is located between the Centerville Powerhouse and the Parrot-Phelan Diversion Dam.

The upper first reach is approximately 2 miles long and is characterized by deep pools, large boulders, and a narrow rocky canyon. Very few fish use this reach because of the barrier created by Quartz Bowl Falls. The second reach begins at an elevation of 960 feet, is approximately 5 miles long, and also is characterized by deep pools, large boulders, and a narrow rocky canyon. The upper 3 miles of this reach, between Quartz Bowl Pool and Pool 4, provides some of the better summer holding habitat for CV spring-run Chinook in Butte Creek (Ward *et al* 2004c). The lower two miles of the reach is characterized by a high pool-to-riffle ratio and by small boulders and more gravel. During a 3-year period, approximately 60 percent of the adult population held in this reach and 43 percent spawned here. The reach contains only 20 percent of the total available spawning habitat.

The third reach is between the Centerville Powerhouse and the Parrott-Phelan Diversion Dam. The reach is approximately 9.05 miles long and consists of two different habitat sections. The first habitat section is 5.50-miles long and extends from the Centerville Powerhouse downstream to Honey Run Covered Bridge with an average stream gradient of 0.65 percent (*i.e.*, 34.2 feet per mile). In this section, the stream channel further widens and more sediment is stored in the channel and banks. According to Williams *et al.* (2002), "[g]ravel bars, particularly at the downstream end of pools, provide good spawning habitat, and the reach provides what appears to us as high quality rearing habitat... Alluvium on the banks supports substantial riparian vegetation, and provides more hyporheic habitat than occurs further upstream." During a 3-year period, approximately 40 percent of the fish held in the lower subreach, while 53 percent spawned in this reach (Ward *et al.* 2003).

In the second habitat section of this lower reach, between Centerville Covered Bridge and Parrott-Phelan Diversion Dam, the stream channel is 3.55 miles long and has an average gradient of 0.43 percent (*i.e.*, 22.6 feet per mile). The habitat between Honey Run Covered Bridge and Parrott-Phelan Diversion Dam generally is considered too shallow to provide good holding habitat for CV spring-run Chinook salmon; only one pool has been identified that is considered deep enough to provide holding habitat. In addition, water temperatures within this reach are typically 21 °C (*i.e.*, 70 ° F) or greater during much of the summer. The area is also easily accessible to the general public and receives heavy recreation use (T. McReynolds, CDFG, pers. comm.). Because few CV spring-run Chinook salmon over-summer in this reach, there is very little spawning that occurs here (P. Ward, CDFG, pers. comm.).

a. *Carrying Capacity of the Spawning Habitat in Upper Reach of Butte Creek Between Quartz Bowl Pool and Centerville Powerhouse*

PG&E's minimum instream flow release requirement at the LCDD is 40 cfs during the holdover period between June 1 and September 14. PG&E typically maintains instream flow releases that exceed the 40 cfs minimum by several cfs to ensure compliance with this requirement. Average monthly flows for June, July, August, and September 1998 through 2002 were 49+, 47+, 47+, and 46+ cfs, respectively. Beginning in mid-September 2004, PG&E, in consultation with CDFG and NMFS, increased flows to 60 cfs for the spawning and incubation period to increase spawning habitat availability. In 2005, flows during this same period were increased to approximately 70 cfs.

Based on recent evaluations of spawning habitat in Butte Creek (USFWS 2003) it is estimated that at flows between 40 and 75 cfs, there is approximately 15,145 to 21,500 square feet of usable spawning gravel between the Quartz Bowl Pool and the Centerville Powerhouse. This represent between 11 and 15 percent of the total amount available to CV spring-run Chinook salmon in Butte Creek. Table 3 shows the estimated amount of spawning gravel and the potential number of redds and spawners expected at different flows. The amount of spawning gravel is estimated by the USFWS (2003). Measurements of Chinook salmon redds were taken for CV spring-run Chinook salmon were taken from Healey (1991) and vary from approximately 23 square feet to over 200 square feet, with an average of 80 square feet. Also, Colleen Harvey-Arrison (CDFG pers. comm. 2004) has estimated that the average redd size in Mill Creek is approximately 104 square feet.

Comparing maximum and minimum reported redd sizes, there appears to be enough available spawning habitat at 40 cfs to support between 76 and 658 redds, or between 152 and 1,316 spawning fish. At 60 cfs there is sufficient gravel to support between 90 and 783 redds, or between 180 and 1,566 spawning fish. At 70 cfs there is sufficient gravel to support between 108 and 935 redds, or 216 and 1,870 spawning fish. At the maximum potential flow of 130 cfs (*i.e.*, assuming no water was diverted into the Lower Centerville Canal to the Centerville Powerhouse) there would be enough gravel to support between 135 and 1,176 redds, or between 270 and 2,352 spawning fish.

As a result of snorkel survey estimates and post-spawning carcass counts, CDFG estimates the number of spring-run Chinook salmon attempting to spawn in the reach above Centerville Powerhouse between 2001 and 2004 was 10,887, 7,161, 1,527 and 5,519, respectively (Ward *et al.* 2005). Studies by CDFG (Ward *et al.* 2004c) indicate that no significant re-distribution of fish holding upstream of Centerville Powerhouse to spawning habitat downstream occurs. In the four years from 2001-2004, CDFG determined that during the holding period between June and mid-September, approximately 65 percent of the observed spring-run Chinook held above the Centerville Powerhouse and 35 percent held below. For the same four year period, CDFG determined approximately 53 percent of the fish spawned in the reach above the Centerville Powerhouse and 47 percent spawned below. Based on an evaluation of available spawning habitat the available spawning habitat has been consistently overutilized in recent years, and likely resulted in redds being superimposed.

Table 3. Estimated number of redds and spawners in Butte Creek for various redd sizes. The estimated number of fish assumes a 1:1 male to female relationship and 2 fish per redd.

Stream Reach	Flow (cfs)	Spawning Gravel Available	Redd Size							
			23 square feet		80 square feet		104 square feet		200 square feet	
			No. Redds	No. Fish	No. Redds	No. Fish	No. Redds	No. Fish	No. Redds	No. Fish
Above Centerville Powerhouse	40	15,145	658	1,316	189	378	146	292	76	152
	60	18,000	783	1,566	225	450	174	348	90	180
	75	21,500	935	1,870	267	534	207	414	108	216
	130	27,048	1,176	2,352	338	676	260	520	135	270
Below Centerville Powerhouse	75	102,000	4,434	8.868	1,275	2,500	981	1,962	510	1,020
	130	126,237	6,664	13,328	1,916	3,832	1,474	2,948	631	1,532

b. *Carrying Capacity of the Spawning Habitat in Lower Reach of Butte Creek between Centerville Powerhouse and Parrott-Phelan Diversion Dam*

The water diverted at the LCDD upstream is returned to the Butte Creek stream channel at Centerville Powerhouse. Average monthly flows in Butte Creek downstream of Centerville Powerhouse for June, July, August, and September of 1998 through 2002 were 171, 158, 145, and 131 cfs, respectively. Based on recent evaluations of spawning habitat (USFWS 2003) there is approximately 126,237 square feet of spawning habitat available to CV spring-run Chinook salmon below the Centerville Powerhouse. This is approximately 75 to 89 percent of the total spawning habitat available to CV spring-run Chinook salmon in Butte Creek.

Table 3 shows the estimated amount of spawning gravel and the potential number of redds and spawners expected at 130 cfs. The amount of spawning gravel is estimated by USFWS (2003). Comparing maximum and minimum reported redd sizes, there appears to be available spawning habitat to support between 631 and 6,664 redds, or between 1,262 and 13,328 spawning adults.

As a result of snorkel survey estimates and post-spawning carcass counts, Ward *et al.* (2005) estimate the number of CV spring-run Chinook salmon spawning in the reach below Centerville Powerhouse between 2001 and 2004 was 7,425, 5,737, 4,536 and 4,702, respectively. This suggests that based on available spawning area, the habitat for these years could either have been under utilized (*i.e.*, using the smallest redd size of 23 square feet), or overutilized (*i.e.*, using the largest redd size of 200 square feet). Using the 80 square feet average size reported by Healey (1991), and the 104 square feet observed by Colleen Harvey-Arrison (pers. Comm. 2004), suggests that the spawning habitat in this reach is most likely to have been slightly overutilized.

B. Factors Affecting the Species and Critical Habitat in the Action Area

The primary factors affecting CV spring-run Chinook salmon and their critical habitat within the action area are: (1) impediments and barriers to adult upstream migration, (2) past operations of hydroelectric facilities, (3) existing operations of the DeSabla-Centerville project.

1. <u>Impediments and Barriers to Adult Upstream Migration</u>

There are two impediments to adult upstream migration within the action area, Quartz Bowl Falls, and the LCDD. Upstream from the LCDD, numerous natural impediments would likely restrict upstream migration if fish were to access this reach.

In all but the wettest of years, when a few adults have been noted as far upstream as LCDD, the maximum upstream distribution of CV spring-run Chinook salmon in Butte Creek is limited by the barrier at Quartz Bowl Falls, an 11.1-foot high waterfall approximately two miles downstream of LCDD. In 1998 and 2003, 25 and 6 CV spring-run Chinook, salmon respectively, were observed between Quartz Bowl Falls and the LCDD (CDFG), which equates to less than 0.1 percent of the observed population in those years (*i.e.*, 20,212 fish in 1998 and 17,294 fish in 2003 as estimated using the Schaefer model). In both of these years, Butte Creek experienced high flows during the late spring, which provided upstream access (CDFG, Williams *et al.* 2002). During high flow conditions that facilitate fish passage over the Quartz Bowl Falls, project diversion rates represent less than one percent of the total flow in Butte Creek, making it unlikely that project diversions would affect adult upstream migration at the falls.

The LCDD was constructed on top of a pre-existing 11.4-foot bedrock cascade/falls, which was likely to have been a significant impediment to anadromous fish migration before the dam was constructed. Yoshiyama *et al.* (2001) concluded that the historical upstream limit of Chinook salmon migration on Butte Creek was in the present vicinity of LCDD.

Barrier surveys by Holtgrieve and Holtgrieve (1995), Johnson and Kier (1998), and Watanabe (2000) found that multiple natural migration barriers exist immediately above LCDD. Of the three Butte Creek barrier surveys, the most accurate and detailed barrier measurements are those of Watanabe (2000). This survey found 3 barriers greater than 14 feet in height located between 0.3 miles and 0.8 miles upstream of LCDD.

A detailed review by Powers and Orsborn (1985) concluded that waterfalls where the change in water surface elevation is in excess of 11 feet can be considered a total barrier to all species of Pacific salmon and steelhead. The validity of Powers and Orsborn's conclusion for Butte Creek is confirmed by the fact that Quartz Bowl Falls meets this criterion (*i.e.*, measured at 11.1 feet) and is a confirmed barrier to Chinook salmon migration for all but a few fish in the wettest years.

Spawning habitat is extremely limited above LCDD. Johnson and Kier (1998) reported 400 square feet of gravel in the 0.54-mile section upstream of LCDD; this section extends up to the second total barrier (*i.e.*, >11-foot) identified on that survey and Watanabe's (2000) survey. Using the maximum and minimum redd sizes reported by Healey (1991), this amount of gravel would support between 2 and 17 redds and between 4 and 34 spawning fish.

2. <u>Past Operation of the DeSabla-Centerville Project</u>

The physical aspects of hydropower facilities affecting Butte Creek date back to about 1899. The Butte County Electric Power and Light Company modified several existing mining ditches and head dams for electric power generation (Ward *et al.* 2003). By 1908 all of the components of the existing facilities had been constructed, including the Butte and Centerville Diversion Dams.

PG&E operates the DeSabla-Centerville project under FERC License No. 803, issued in 1980. The existing license allows diversions of flows from Butte Creek at two points (*i.e.*, Butte and Centerville Diversion Dams). Additionally, PG&E diverts flows from the WBFR at the Hendricks Head Dam. At the DeSabla Forebay, WBFR water combines with flows diverted at the Butte Diversion Dam before being discharged into Butte Creek, approximately 1 mile upstream from the anadromous habitat in Butte Creek. Summer flows below the LCDD were frequently less than 10 cfs. During this period, water temperatures generally were too warm to support spring-run Chinook salmon upstream from the Centerville Powerhouse.

In 1984, FERC License No. 803 was amended to require PG&E to release a minimum of 10 cfs below the LCDD from May 16 through September 14. This requirement was further conditioned to include the additional release of up to 40 cfs to maintain water temperatures less than 20 °C in the salmon holding pools below LCDD (*i.e.*, from Quartz Bowl Pool downstream to Pool 4), from July 1 to September 14 during normal water years. The flow requirement was amended again in 1992 and required PG&E to release a minimum of 40 cfs below LCDD during June 1 through September 14, in all water years. The remainder of the flow is diverted into the LCDD for power generation at the Centerville Powerhouse. The full flow of Butte Creek, including the water diverted from the WBFR, enters Butte Creek at the Centerville Powerhouse. The 1992 amendment also required PG&E to implement a monitoring plan to assess streamflow and temperature.

Concern for the effects of the PG&E DeSabla-Centerville project on the survival of CV spring-run Chinook salmon date back to at least 1940, and were first documented in 1960 (Salo 1960). Salo (1960) estimated more than 1,000 to 2,000 adult Chinook salmon died prior to spawning above the Centerville Powerhouse due to low flows (*i.e.*, less than 10 cfs), and warm water temperatures (CDFG 1998, Ward *et al.* 2003). Salo also observed several hundred salmon holding in good condition below the Centerville Powerhouse, and noted than the reach above the Centerville Powerhouse would not support more that 250 spawning salmon at any flow. Following these findings, CDFG constructed a removable fish barrier dam above the Centerville Powerhouse to confine all Chinook salmon to the reach below the powerhouse. This action reduced the quantity of holding and spawning habitat for the salmon, but limited their exposure to low flow conditions and high water temperatures. From 1970 to 1980, an average of 229 salmon held in Butte Creek below the Centerville Powerhouse. The barrier dam was removed in the 1980s (Ward *et al.* 2003). From 1981 to 1992, the average number of adult spring-run Chinook salmon holding in Butte Creek increased to 551 fish.

PG&E initiated a series of studies in 1984 to evaluate the effectiveness of increasing flows in the reach above the Centerville Powerhouse to meet temperature targets. Kimmerer and Carpenter (1989) produced a model showing that flows between 20 and 40 cfs created the most temperature reduction per unit of flow. Another assessment of water flow and temperature was completed in 1993. This assessment focused on the WBFR and resulted in the following key findings and recommendations (PG&E 1993, Ward *et al.* 2003):

- Increased diversions of WBFR water would not lower temperatures in the Hendricks Toadtown Canal but would reduce residence time and water heating in the DeSabla Forebay which would slightly reduce temperatures at the LCDD.

- Decreased diversion of Butte Creek into the Butte Canal would increase temperatures at the LCDD by increasing residence time in the DeSabla Forebay, and increasing the flow in the natural channel of Butte Creek which warms more quickly then flows in the Butte Canal.

- Increased diversions from at the Butte Diversion Dam and from the WBFR reduce residence time in the DeSabla Forebay and provide the coolest possible temperatures at the LCDD.

CDFG responded to these findings by recommending further assessment of (1) flow releases from Round Valley and Philbrook Reservoirs to identify where it was possible to reduce temperatures in Butte Creek; (2) options for conveying water around or through the DeSabla Forebay to reduce residence time and water heating; and (3) maintain minimum flows below LCDD until after CV spring-run Chinook salmon emergence to avoid dewatering any redds. FERC subsequently concluded in a 1997 order approving the water temperature study report, that changes to the DeSabla Forebay would reduce operational flexibility and required the following:

- Discharges from Round Valley Reservoir shall be limited to minimum flow whenever the average daily temperature of the discharge exceeds 17 °C to the extent possible.

- Discharges from Philbrook Reservoir shall be limited to minimum flow whenever the average daily temperature of the discharge exceeds 18 °C to the extent possible.

The operational changes that have occurred since the license was first issued have reduced water temperatures and increased streamflows in the reach below LCDD. These changes have improved the quantity and quality of several primary constituent elements of critical habitat including freshwater migration corridors, freshwater spawning habitat, and freshwater rearing habitat. These improved conditions primarily result in improved holding and spawning conditions for adult spring-run Chinook salmon in Butte Creek. From 1991 to 1997, the average number of adult holding spring-run Chinook salmon in Butte Creek increased again to 1,900 fish.

3. Current Operation of the DeSabla-Centerville Project

Since the water temperature study was completed, PG&E has developed and implemented Annual Operations and Management Plans (PG&E 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006). The basic objective of the plan is to manage Round Valley and Philbrook Reservoir releases to maintain temperatures in Butte Creek that are as cold as possible for CV spring-run Chinook salmon holding below the LCDD and the Centerville Powerhouse. The plan seeks to maintain temperatures at the Hendricks Head Dam diversion at 16 °C or less through the first week in September and 15 °C or less thereafter. Additionally flows into the DeSabla Forebay are to be managed to minimize residence time and water heating, and PG&E monitors water temperatures at the DeSabla Powerhouse and consults with NMFS, CDFG, and USFWS when discharge temperatures exceed 16 °C. Under the annual operating plan, temperature monitoring stations were installed throughout the WBFR and Butte Creek to allow water temperature assessments necessary to develop modifications to ongoing and future plans that minimize temperatures in Butte Creek. In 2004, an air temperature forecasting tool was introduced to the annual operating plan to assist in managing water temperatures during extreme heat events.

The existing operation of the PG&E DeSabla-Centerville project primarily affects adult holding and spawning CV spring-run Chinook salmon and their habitat through the control of the summer and fall instream flow regime in Butte Creek. Current instream flow regimes affect holding and spawning habitat availability, and summer water temperatures. Together these conditions influence the abundance, distribution and survival of CV spring-run Chinook salmon in Butte Creek. The effects of water temperature on juvenile Butte Creek spring-run Chinook salmon, is not significant because 99 percent of the juveniles outmigrate as fry and are not exposed to summer water temperatures. Since PG&E began to use Annual Operations and Maintenance Plans in 1999, the average number of adult holding spring-run Chinook salmon in Butte Creek has increased to 6,943.

Water temperature and stream flow within anadromous habitat are affected by a number of variables, including existing DeSabla-Centerville operations and facilities within the WBFR and Butte Creek. This section will discuss how the operations of certain facilities, including Round Valley Reservoir, Philbrook Reservoir, the DeSabla Forebay, the Butte Canal, and the Lower Centerville Canal, affect water temperature and stream flow throughout the action area.

a. *Round Valley Reservoir*

Water from Round Valley Reservoir is released into the WBFR. Water from the WBFR is subsequently diverted from the WBFR through Hendricks and Toadtown canals, after which it joins with water in Butte Canal, travels through DeSabla Forebay, and is ultimately released into Butte Creek at DeSabla Powerhouse. Accordingly, water released from Round Valley Reservoir has the potential to affect water temperatures in Butte Creek.

Due to its shallow depth relative to its large surface area, the water temperature in Round Valley Reservoir gradually increases during the summer with similar temperatures being observed throughout the depth of the water column (*i.e.*, it is isothermal) (PG&E 1994). Water temperatures in Round Valley Reservoir warm up relatively quickly in the spring following the snowmelt and are near 20 °C by early summer. Data collected by PG&E indicates that July temperatures ranged from 15.5 to 22.7 °C, and August temperatures ranged from 16.1 to 23.7 °C. Releases from Round Valley Reservoir mix with cold spring water at the confluence of Coon Hollow Creek. Ongoing water temperature monitoring shows that typical releases from Round Valley Reservoir do not influence water temperatures at Butte Creek because of the overwhelming effect of cold water at Coon Hollow Creek.

Conditions in WBFR above its confluence with Philbrook Creek were monitored by PG&E from 1998 to 2003. This location best represents the combined influence of water releases from Round Valley Reservoir, and the spring-water influence at the confluence of Coon Hollow Creek. July daily average water temperatures at this location ranged from 8.6 to 13.9 °C over a 5-year period. Daily average water temperatures in August ranged from 6.6 to 12.5 °C during the same period.

b. *Philbrook Reservoir*

Philbrook Reservoir is the largest of the project's storage reservoirs. Water is released from Philbrook Reservoir into Philbrook Creek, which joins with the WBFR approximately 2 miles downstream of Philbrook Reservoir. Water from the WBFR is subsequently diverted from the WBFR through Hendricks and Toadtown canals, after which it joins with water in Butte Canal, travels through DeSabla Forebay, and is ultimately released into Butte Creek at DeSabla Powerhouse. Accordingly, water released from Philbrook Reservoir has the potential to affect water temperatures in Butte Creek.

Philbrook Reservoir exhibits stronger thermal stratification than Round Valley Reservoir due largely to its greater depth and total volume. Near-surface water temperatures in Philbrook Reservoir ranged from 7.1 to 24.9 °C during the 1992 to 1993 monitoring program. Bottom water temperatures during the same period ranged from less than 5.0 to 21.9 °C. The difference between surface and bottom water temperatures in Philbrook Reservoir was greatest in 1993, averaging 7.4 °C, with a maximum of 13.7 °C (PG&E 1994). Maximum stratification occurs in early summer and begins to decline as soon as increased water releases begin.

In general, the cool water pool in Philbrook Reservoir amounts to no more than about 1,500 acre-feet, which is a quantity sufficient to make cool releases for about 20 days assuming Philbrook releases of 35 cfs, or 30 days assuming releases of 25 cfs. The water released from storage in Philbrook Reservoir and diverted to DeSabla Forebay helps to reduce water temperatures in Butte Creek by delivering a source of cold water during early summer, and by reducing transit time of water as it moves through the system on-route to Butte Creek. Transit times are reduced because a higher discharge level can be released from Philbook compared to Round Valley, and because Philbrook water has a shorter travel distance that Round Valley water. The higher flows and shorter travel reduce the transit time. The reduced transit times minimize thermal loading in the canals and through the forebay. The contribution of Philbrook releases for the first 20-30 days contributes to reducing the temperature of the water entering the forebay during the warmest part of the summer.

c. *Butte Canal Operations*

The project diverts water from Butte Creek Diversion Dam through Butte Canal and into DeSabla Forebay before returning the diverted water to Butte Creek at DeSabla Powerhouse. Accordingly, Butte Canal operations have the potential to affect water temperatures in Butte Creek. As discussed below, the diversion of water through Butte Canal benefits CV spring-run Chinook salmon in Butte Creek by providing cooler water at DeSabla Powerhouse than would have been produced if the water had traveled down the natural channel.

The diversion of water at Butte Creek Diversion Dam and conveyance through the Butte Canal has the effect of reducing the heating (*i.e.*, thermal loading) of the diverted water by reducing the travel time and exposure to solar radiation relative to the natural channel. The total length of the Butte Canal system is 11.5 miles. The relatively fast transit time of the diversion system moderates temperature changes within the canal. Based on data collected by PG&E (1992–1993), temperatures increased an average of 0.67 °C through the canal during the July through August period. The average change in temperature converts to a thermal loading of 0.06 °C per mile.

In comparison to the diversion of water through Butte Canal, water transported through the natural channel travels at a much slower rate. The total length of the bypass reach (*i.e.*, the natural Butte Creek stream channel) between Butte Creek Diversion Dam and DeSabla Powerhouse is approximately 10 miles. Although the distance is slightly shorter than in the Butte Canal, the higher roughness and width-to-depth ratio of the natural channel contribute to create a higher rate of thermal loading. Based on data collected by PG&E (1992–1993), temperatures increased an average of 3.5 °C through this natural channel during the July through August period, which calculates to an average thermal loading of 0.37 °C per mile.

Even when combined with 1.0 to 1.5 °C heating that occurs in DeSabla Forebay, the smaller 0.67 °C increase through the Butte Canal suggests that the temperature of the diverted water is 1.5-2 °C cooler when it reaches DeSabla Powerhouse than it would have been had it traveled down the natural channel.

This estimate closely matches PG&E's observed summer water temperatures in 2004. The water delivered through DeSabla Powerhouse in June, July, and August averaged 2 °C cooler than Butte Creek upstream of DeSabla Powerhouse. As a result of the addition of this cooler water from DeSabla Powerhouse, the average monthly temperature of Butte Creek at LCDD was 1.4-1.6 °C cooler than upstream of DeSabla Powerhouse. While the extent of thermal loading in the natural channel between Butte Creek Diversion Dam and DeSabla Powerhouse may decrease with higher flow releases from the Butte Creek Diversion Dam, no temperature model has been developed for this reach to quantify the potential for this temperature change. However, increased instream flow releases at the Butte Creek Diversion Dam could result in a net increase in the water temperatures at LCDD. This water temperature increase would occur as a result of two processes at work in this system. First, an increase in temperature due to natural thermal loading in the natural channel from Butte Creek Diversion Dam to DeSabla Powerhouse would occur, as discussed above. Second, reducing the flow in the Butte Canal (by increasing the instream flow release at Butte Creek Diversion Dam) would also decrease the total flow through DeSabla Forebay, increasing travel time through the forebay, and contributing to increased heating of water ultimately released from DeSabla Forebay at DeSabla Powerhouse. Thus, as the warmer water that traveled through the natural channel combined with the warmer water coming from DeSabla Forebay, the net temperature at LCDD would increase.

d. *DeSabla Forebay*

The project moves water through Butte Canal and into DeSabla Forebay before returning the diverted water to Butte Creek at DeSabla Powerhouse, which is located 0.2 miles above LCDD (*i.e.*, approximately 2 miles upstream from anadromous fish habitat). This diversion of water from upper Butte Creek into DeSabla Forebay has the potential to affect the temperature of the diverted water. The absolute change in water temperature (Δ-T) that occurs in the DeSabla Forebay is defined as the difference in daily average temperature measured from the point at which the diverted water first enters DeSabla Forebay (*i.e.*, the inflow from Butte Canal) and the point at which the diverted water is returned to Butte Creek at the DeSabla Powerhouse tailrace.

Based on the data collected by PG&E during the 1992 to 1993 and 2002 to 2003 monitoring programs, the change in temperature through the DeSabla Forebay averaged 1.1 °C for the July 1 through August 31 period. A frequency analysis performed on the Δ-T values, using the 1992 to 1993 and 2000 to 2003 data indicated that 47.2 percent of the July through August Δ-T values were between 1.01 and 1.50 °C. Furthermore, this analysis indicated that 18.2 percent of the Δ-T values were greater than 1.51 °C and 34.6 percent of the values were less than 1.00 °C (PG&E 2005).

Heating of water in the DeSabla Forebay is primarily the result of the increased residence time and greater surface area of this small reservoir as compared to the canal section of the system. In 1993, PG&E conducted dye dilution studies to define travel time through the various project reaches (PG&E 1994). This study determined that retention time in DeSabla Forebay is significantly influenced by the volume of incoming water. Travel-time through the forebay during periods of maximum inflow was 8.9 hours at 201 cfs, compared with 18.9 hours at 107 cfs.

Existing temperature monitoring studies have shown that maintaining a high flow through the DeSabla Forebay minimizes the heating that can occur in the forebay. The Annual Operations and Maintenance Plans reflect this information and maximize inflows into the forebay during summer months. Regardless, thermal loading through the DeSabla Forebay occurs at a higher rate per distance than anywhere else in the action area and modifications to the forebay may represent the best opportunity to reduce thermal loading during summer months.

e. *LCDD*

Butte Creek flow is diverted into the Lower Centerville Canal at LCDD. Water reaching LCDD is split into two different routes. Approximately 45 cfs (*i.e.*, 40 cfs plus a buffer to ensure license compliance) is released to Butte Creek below LCDD, while the remaining water is diverted into the Lower Centerville Canal and released to Butte Creek at Centerville Powerhouse. This diversion directly affects the quantity and quality CV spring-run Chinook salmon holding, and spawning habitat in Butte Creek.

(1) *Water Temperature below LCDD.* The current 40 cfs minimum flow release below LCDD was adopted because it provides an efficient means of moderating water temperatures (*i.e.*, a large reduction in thermal load for the flow released) in the upper reach, while conserving cool water in the canal for the benefit of CV spring-run Chinook holding below Centerville Powerhouse. As flows in the upper reach increase above 40 cfs, each additional increment of flow not only becomes less effective at moderating temperatures (i.e., reducing thermal loading), but may produce warmer water below the Centerville Powerhouse. This net warming would occur because water flowing down the natural channel experiences greater thermal loading, due to increased travel time and more direct exposure to solar radiation in a wide stream channel, as compared to water traveling within the narrow and fast moving Lower Centerville Canal.

Water that is discharged at the Centerville Powerhouse mixes with the water in the natural channel resulting in a net cooling of water below Centerville Powerhouse, thereby enhancing downstream holding habitat. Due to reduced travel time, the relatively deep and narrow conveyance structure, and shading along the Lower Centerville Canal, water delivered via the canal at Centerville Powerhouse is cooler by approximately 2 °C during July and August compared to the water in Butte Creek immediately above the Centerville Powerhouse (PG&E 2004). In 2004, the mean canal water temperatures during the July-August period were 2.6 °C cooler than in Butte Creek upstream of Centerville Powerhouse (*i.e.*, 18.0 vs. 20.6 °C), while Butte Creek downstream of the powerhouse was 1.6 degrees cooler than upstream (19.0 vs. 20.6 °C). The combination of cool water and relatively high flows released from Centerville Powerhouse help to maximize the proportion of the population that holds downstream of the powerhouse. Between 2001 and 2004, from 31.3 percent to 50.6 percent of the adult salmon observed during the annual snorkel survey were found downstream of Centerville Powerhouse (Ward *et al.* 2005), with an average of 37.8 percent of the population holding in this area.

Although the reduced transit times and thermal loading associated with upstream water diversions generally have a cooling effect on summer water temperatures in anadromous habitat, severe hot weather events can affect basin-wide water temperatures and cause stressful conditions for CV spring-run Chinook salmon in Butte Creek. Extended hot weather in July 2003 caused water temperatures in key over-summer holding pools to reach average daily water temperatures of 20.9 °C (Ward *et al.* 2004c). The combination of the high numbers of pre-spawning adults confined to the limited number of holding pools, and the elevated water temperatures led to disease outbreaks, resulting in a large number of pre-spawn mortalities. During the last two weeks of July 2002, and 2003, air temperatures exceeded 37.6 °C (*i.e.*, 100 °F) for 10 of those days. These air temperatures fell in the upper 10 percent for the period of record. These temperature conditions, coupled with the high fish densities, led to an outbreak of two diseases, columnaris and ich, resulting in pre-spawn mortalities. In 2003, 11,231 adults died prior to spawning. Ninety percent of these fish died in the reach above the Centerville Powerhouse. The majority of the fish died in the uppermost pools with the coolest water temperatures. These factors suggest that the high mortalities were density dependant events that were triggered by the high water temperatures.

Studies by CDFG (Ward *et al.* 2004c, Ward *et al.* 2005) have suggested that pre-spawning mortality is limited during summers when average daily water temperatures at Quartz Bowl (1 mile downstream of LCDD) do not exceed 19.4 °C for extended periods of time (as in 2001 and 2004). Significant pre-spawning mortality was triggered in 2002 and 2003 when mean daily water temperatures exceeded 19.4 °C for 16 days and 11 days, respectively. However, temperatures below this threshold still may cause low levels of adult mortality. In 2006, when prolonged hot weather conditions resulted in temperatures that peaked at 19.1 °C, preliminary estimates indicate that probably fewer than 15 fish died. Although temperature appears to be the primary factor associated with pre-spawning mortality, high densities of adult Chinook salmon have also been identified as a possible contributing factor to the disease outbreaks which caused the pre-spawning mortality in 2002 and 2003. Regardless, given the current understanding of climate change, it is reasonable to assume that the frequency of extreme heat events is likely to increase over the 50-year period of the license.

(2) *Habitat Availability below LCDD*. In the upper bypass reach between LCDD and Centerville Powerhouse, the project's diversion of water from LCDD to Lower Centerville Canal affects instream spawning habitat for Chinook. Beginning in 2004, PG&E, through informal consultation with NMFS and CDFG, increased instream flows to 60 cfs in the bypass reach during September through February to provide additional spawning habitat. In 2005, flows were increased to 75 cfs during the same period. These flow adjustments increased available spawning habitat by 19 to 26 percent. The amount of habitat available at different project-related flows was previously described in the environmental baseline under the sub-section *Carrying Capacity of the Spawning Habitat in Upper Reach of Butte Creek Between Quartz Bowl Pool and Centerville Powerhouse.*

C. Projected Status of Species and Critical Habitat Assuming the Proposed Continuing Action Will No Longer Be Authorized, Funded, or Carried Out

If the proposed action of relicensing the DeSabla-Centerville project to continue similar operations for the next 50 years was not authorized, funded, or carried out, diversion actions would discontinue, and certain project facilities such as diversion dams, canals and flumes, forebays, penstocks, and powerhouses would be removed or decommissioned. Cessation of water diversions would result in warmer water temperatures in the anadromous reaches of Butte Creek and would adversely affect the conservation value of several primary constituent elements of critical habitat including the quantity and quality of holding, spawning and rearing habitat. Because the project diverts a relatively low percentage of the overall flow during early spring months when adults are migrating upstream, it is unlikely, that without the action, more fish would be able to ascend the Quartz Bowl falls

During an unimpaired flow, the interbasin transfer of WBFR would not occur, and Butte Creek flows that are currently diverted into the Butte Canal, at the Butte Diversion Dam would remain in the natural channel. During adult holding and spawning periods, flow would increase from 40/45 cfs to approximately 75 cfs between the LCDD and the Centerville Powerhouse. Flow would be reduced below the Centerville Powerhouse by approximately 40 percent to 76 cfs.

Table 3 shows the estimated amount of spawning habitat that would be expected at a flow of 75 cfs. Seventy-five cfs represents a flow that approximates the average unimpaired flow for the holding and spawning period as indicated above. These calculations for the estimated number of redds and spawners are flow-related, and based on the assumption that there would not be a corresponding change in water temperature during fall months, when the effects of thermal loading are substantially reduced, or a change in the distribution of holding and spawning fish. The flow change would cause a corresponding increase in the amount of spawning habitat available in the reach above the Centerville Powerhouse, and would decrease habitat availability below. Above Centerville Powerhouse, spawning gravel availability would increase by approximately 6,355 square feet. Using average redd size of 80 square feet, as reported by Healey (1991), this would result in an increase from 189 redds, and 378 fish at 40 cfs, to 267 redds and 534 fish at 75 cfs, for an increase of 78 redds and 156 fish. The flow changes below the Centerville Powerhouse would result in an average decrease of 54 cfs. Spawning gravel availability would decrease by approximately 24,237 square feet. This would result in a decrease from 1,916 redds, and 3,832 fish at 130 cfs, to 1,275 redds and 2,500 fish at 75 cfs, for a reduction of 641 redds and 1,332 fish. The overall change would be a decrease of 563 redds, for a total of 1,542, and a decrease of fish by 1,276 for a total of 3,034.

Based on available information, it is not entirely possible to predict what water temperatures would be below the Quartz Bowl Pool. Past thermal studies in the Butte Canal and in Butte Creek below the Butte Creek Diversion Dam, the Kimmerer and Carpenter model (1989), and ongoing PG&E water temperature monitoring results from the 2003 to 2005 Annual Operating Plans, provide some insight to unimpaired flow/temperature relationships.

In July and August, the average daily water temperatures at Pool 4 range from 18.5 to 20 °C. Using the Kimmerer and Carpenter model, doubling the flow from 40 to 80 cfs would reduce the mean daily water temperature at Pool 4 to 17.9 to 19.4 °C. Based on PG&E's ongoing water temperature monitoring, the water temperature between Pool 4 and the Centerville Powerhouse would be expected to increase another 2.0 °C, resulting in average daily water temperatures between 19.9 and 21.4 °C. Existing daily average water temperatures measured immediately above the Centerville Powerhouse range from 19.9 to 20.6 °C. The difference between existing water temperatures appears to be greatest in the upper portion of the reach near Pool 4, but small at the lower end of the reach, above the powerhouse. This suggests that only a small reduction in water temperatures above the Centerville Powerhouse would occur under unimpaired conditions, and the reduction would not likely extend far past the Centerville Powerhouse.

Additionally, the Butte Canal temperature studies suggest that under an unimpaired flow regime, water temperatures at the location of the DeSabla Powerhouse would increase by 1.5 to 2 °C. This would increase water temperatures at Pool 4 and Centerville Powerhouse by as least as much. The discontinuation of WBFR diversions would increase the transit time of water between the DeSabla and Centerville Powerhouses and contribute to additional thermal loading, and probably even higher temperatures in Butte Creek.

These studies suggest that under an unimpaired flow regime, the summer water temperatures below the Centerville Powerhouse would be too warm to support holding adult spring-run Chinook salmon. The entire Butte Creek population would probably hold in the reach above the Centerville Powerhouse, primarily in the upper three miles. Based on CDFG's spawning survey data, some fish (*i.e.*, up to 20 percent) may relocate downstream to spawn, when fall water temperatures decline. However, they would be more likely to spawn in the lower 2 miles of the reach above the powerhouse, rather than migrate several miles downstream to spawn below the Centerville Powerhouse. Under this scenario, there would be a net loss of 102,000 square feet of spawning gravel, enough to support 1,275 redds, or 2,500 fish. Using average redd sizes, under unimpaired flow conditions, it is reasonable, therefore, to assume that Butte Creek would be able to support a maximum of 267 redds, or 534 adult fish.

D. Likelihood of species continued use of habitat within the action area

Butte Creek historically played only a minor role in supporting CV spring-run Chinook salmon (Moyle 2002). Its significance to the survival and recovery of the spring-run Chinook, however, has since greatly increased as one of only three principal habitats for the ESU that remain (Moyle 2002). Butte Creek's enhanced importance has been a result of streambed alterations that have occurred over time as well as PG&E project operations that provide supplemental flows from the WBFR. The predominance of the Butte Creek spring-run Chinook salmon reflects successful efforts to restore the fishery through refinements to the operation of PG&E's DeSabla-Centerville project and through other actions initiated under the CVPIA that have improved adult and juvenile fish passage through lower Butte Creek, the Butte Sink, and the Sutter Bypass, through the construction state-of-the-art fish screens and fish ladders.

As a result of restoration actions undertaken by the CVPIA (*i.e.*, upstream fish passage improvement and fish screen installation) and PG&E (*i.e.*, instream flow increases and improved water temperature management), and beneficial growth conditions in the Pacific Ocean, large numbers of adult CV spring-run Chinook salmon have returned to Butte Creek in recent years. These returns have been at levels far in excess of historical numbers and the restoration goals of resource agencies (*i.e.*, the AFRP goal for doubling the natural production of CV spring-run Chinook salmon in Butte Creek is 2,000 returning adults (USFWS 2001)).

Additionally, outmigrant counts conducted by CDFG at the Parrot-Phalen Diversion Dam indicate high levels of successful reproduction: in 1998, 410,115 emigrating spring-run Chinook were counted; in 2000, 697,317; and in 2003, 330,350 (PG&E 2005). The significant pre-spawning mortality that has occurred in recent years is likely related to limited habitat availability coupled with unusually high temperatures. Although high levels of pre-spawning mortality such as occurred in 2003 are of concern, data suggest that spawning levels and the number of juvenile outmigrants would not have been significantly greater than they were in 2003 because of the limited spawning habitat in Butte Creek.

Although the number of returning adults and juvenile outmigrants have been high in recent years, the capacity of Butte Creek to support spring-run Chinook salmon is not unlimited. In recent years, it appears that the population of spring-run Chinook salmon may have reached or exceeded Butte Creek's carrying capacity.

Recent and ongoing collaborative habitat restoration activities, modifications to the operation of the DeSabla Centerville project, and the positive population response to these efforts, suggest that spring-run Chinook salmon will continue to survive and recover in the action area. In their recent evaluation of the viability of Central Valley salmonids, Lindley *et al.* (2006) found that Butte Creek spring-run Chinook salmon satisfy several important viability criteria, and conclude that if current conditions hold into the future, the population has a low risk of extirpation (*i.e.*, 5 percent chance over 100 years).

V. EFFECTS OF THE ACTION

This section describes the known or potential direct and indirect effects of the proposed action and any interrelated and interdependent actions, on CV spring-run Chinook and critical habitat that may occur as a result of the physical presence of project facilities, project operations and maintenance activities. Since the proposed project is identical to the existing project, the preliminary effects analysis evaluates the continuation of the action for the proposed licensing period of 50 years.

Each identified effect includes a brief explanation of the potential factor that may affect the species, and an assessment of the species' response to those environmental factors based on the best available scientific and technical information.

A. Approach to the Assessment

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species. This biological opinion assesses the effects of the proposed action on threatened CV spring-run Chinook salmon and their designated critical habitat. The proposed action may affect CV steelhead and their designated critical habitat, but at the request of FERC, such effects will not be considered in this preliminary biological opinion

In the *Description of the Proposed Action* section of this biological opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this biological opinion, NMFS provided an overview of one of the threatened species and critical habitat that are likely to be adversely affected by the activity under consultation.

NMFS generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or a sound). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). We then use the evidence available to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

To evaluate the effects of the proposed action, NMFS examined the proposed action and conservation measures to identify likely impacts to listed anadromous salmonids within the action area based on the best available information. The primary information used in this assessment includes species population information previously described in the *Status of the Species* and *Environmental Baseline* sections of this biological opinion; studies and accounts of the impacts of the proposed action on anadromous species; and documents prepared in support of the proposed action, including the August 2005 BA (PG&E 2005).

B. Assessment

The assessment will consider the nature, duration, and extent of the proposed action relative to the migration timing, behavior, and habitat conditions, life history stages, and habitat requirements of Federally listed CV spring-run Chinook salmon. This assessment will consider the effects of the continued project facilities and their operations and maintenance over the course of the proposed period of the license (*i.e.*, 50 years).

1. Effects Related to the Physical Presence of Project Facilities

The physical presence of certain in-channel project facilities has the potential injure or kill anadromous fish by impeding upstream migration of adults, and causing false attraction to areas that do not provide salmonid habitat. Facilities that are within anadromous habitat and that are considered here include the LCDD and the Centerville Powerhouse outlet and bypass channel.

a. *Effects of the LCDD*

There is a potential for the upstream migration of adult spring-run Chinook salmon to be affected by the presence of the LCDD, because the LCDD does not have a fish ladder. As described in the *Environmental Baseline* section, a very small number (*i.e.*, approximately 0.1 percent) of the adult spring-run population migrates upstream past Quartz Bowl Falls, and only in infrequent years. Two miles of holding and spawning habitat are present between the Quartz Bowl Falls and the LCDD. Considering the low number of adult fish ascending Quartz Bowl Falls, any fish that enter this reach of habitat are highly likely to have sufficient habitat available to hold and spawn without resulting in any injury or death.

Furthermore, an assessment of passage conditions and habitat suitability conducted by PG&E (2004) indicates that even if fish were to pass the LCDD, the conservation value of the available habitat would be low and not capable of supporting many holding or spawning fish due to high channel gradient, lack of holding pools, lack of spawning habitat, and the presence of an impassible natural barrier (*i.e.*, 30-foot waterfall) approximately 0.6 miles upstream from the LCDD.

b. *Potential effects at the Centerville Powerhouse*

The Centerville Powerhouse and bypass channel outlets have the potential to falsely attract adult and juvenile salmon. The powerhouse outlet pool is laterally isolated from Butte Creek by a cement wall. The pool connects with Butte Creek approximately 20 feet from the outlet at the downstream end of the pool. In the 1980's, modifications were made to the powerhouse outlet that connected the downstream end of the outlet pool channel to Butte Creek under all flow and discharge conditions. In the event that flows through the powerhouse outlet are temporarily discontinued, fish that enter the pool cannot become stranded and are able to swim out of the outlet pool, into the main channel of Butte Creek, and avoid being injured or killed. There also is a potential for adult and juvenile salmon to be falsely attracted to the Centerville Powerhouse Spillway Channel and become stranded. This could occur when the powerhouse goes offline or spills excess water into the bypass channel instead of moving it through the powerhouse. The bypass channel has a steep, continuous grade, and the channel is composed of angular quarry rock. The channel geometry, slope, and entry of the channel to Butte Creek at a shallow riffle make it unlikely that adult or juvenile Chinook salmon are falsely attracted and injured or killed by this facility.

2. <u>Effects of Project Operations and Maintenance</u>

As previously discussed in the *Environmental Baseline* section of this biological opinion, existing operation and maintenance of the PG&E DeSabla-Centerville project affects CV spring-run Chinook salmon and their critical habitat primarily through the control of the summer and fall instream flow regime in Butte Creek. Current instream flow regimes affect holding and spawning habitat availability, and summer water temperatures. Together these conditions influence the distribution of CV spring-run Chinook salmon in Butte Creek, which, in turn, influences pre-spawning survival, adult fecundity, spawning success, and ultimately juvenile production.

Adult upstream migration is affected by stream flow, water temperature and channel geometry. Adult upstream migration into the action area begins in February and extends into late-June, but peaks between March and May. Project operations do not appear to adversely affect adult migration. Butte Creek stream flows during the migration period allow unimpeded migration through the action area. Other than at Quartz Bowl Falls and LCDD there are no know critical riffles or other upstream passage impediments known to affect CV spring-run Chinook salmon in the action area. Water temperatures during the peak of the adult migration period are below 65 °C, a level where upstream migration tends to stop.

The adult summer holding period for CV spring-run Chinook salmon generally is considered to be June through mid-September. In Butte Creek, streamflow is adequate, and habitat availability and quality for adult summer holding is primarily a function of water temperature, which is affected by the project as a result of its water storage facilities, and water delivery practices and schedules.

Spawning begins in late September and extends into November. Spawning habitat availability is affected by project-related flows. The interbasin transfer of WBFR water, and the reduced transit times of water transported through canals upstream from the LCDD, reduces water temperatures at the LCDD below what they would be without the action. Similarly, as a result of diversions at the LCDD, water temperatures have been substantially reduced below the Centerville Powerhouse, where a large amount of spawning gravel is available. Reduced water temperatures result from reduced transit time and greater shading along the Lower Centerville Canal compared to the natural channel of Butte Creek. This, together with diversions from the WBFR, creates conditions that support additional summer holding habitat for CV spring-run Chinook salmon below the Centerville Powerhouse that would not otherwise exist. The temperature reduction in Butte Creek produced by project operations enhances habitat conditions for over-summering adults, thereby increasing their rate of survival.

Ward *et al.* (2003) concluded that the project-related flow and temperature regime appears to have maximized survival and spawning success, and that existing evaluations suggest that there is little potential to decrease temperatures by increasing flows in the reach above the Centerville Powerhouse during summer holding periods. This report also found that current diversions through the Centerville Powerhouse significantly decrease temperatures in Butte Creek below the Centerville Powerhouse, provide important holding habitat during the summer, and ultimately contribute to the maximum usage of available spawning habitat. While the Upper Centerville Reach contains the majority of the available spring-run Chinook salmon holding habitat, more than 80 percent of the available spawning habitat occurs downstream of Centerville Powerhouse (USFWS 2003). By encouraging CV spring-run Chinook salmon to hold below Centerville Powerhouse, the proposed action encourages efficient utilization of spawning habitat.

In contrast to unregulated, without-action flow conditions, the project will result in a loss of 6,355 square feet of spawning area in Butte Creek above the Centerville Powerhouse, and an increase of 126,237 square feet below the powerhouse, for a net increase of 119,882 square feet of spawning area, 1,499 redds, or 2,998 fish.

Although water that is imported to Butte Creek from the WBFR generally has a cooling effect on summer water temperatures, severe hot weather events can affect basin-wide water temperatures and cause stressful conditions for CV spring-run Chinook salmon in Butte Creek. Extended hot weather in July of 2002 and 2003 caused water temperatures in key over-summer holding pools to reach average daily water temperatures of 20.9 °C (Ward *et al.* 2004c).

If flow in the Lower Centerville Canal is reduced and left in the natural channel above the Centerville Powerhouse, it could help to decrease water temperatures in the upstream pools where the majority of pre-spawn mortalities are observed. However, increasing the flow could cause fish holding below the Centerville Powerhouse to be attracted upstream. This could result in overcrowding of the available habitat. As observed in 2002 and 2003, overcrowding, when coupled with extreme heat events, would significantly increase the risk of mortality due to disease and reduce the potential for successful spawning.

Changing the flows to improve water temperatures above Centerville Powerhouse would result in increased water temperatures below the Centerville Powerhouse. Between 2001 and 2004 the population of adult spring-run Chinook salmon in the Upper Centerville Reach exceeded available spawning habitat. During this same period, spawning habitat downstream of Centerville Powerhouse was underutilized. This same situation occurred in 2003, following the largest pre-spawning mortality. Ward *et al.* (2004c, 2005) found only limited downstream movement from holding habitat in the Upper Centerville Reach to spawning habitat below the powerhouse. Thus, increasing the concentration of adults with higher minimum summer flows from LCDD could reduce the overall reproductive potential of the Butte Creek spring-run Chinook population. It would potentially increase overcrowding of spawning habitat in the Upper Centerville Reach and reduce the utilization of spawning habitat downstream of Centerville Powerhouse. This overcrowding, when coupled with potential heat events such as those experienced in 2002 and 2003, could also increase the risk of mortality due to disease and high temperatures, and reduce the potential for successful spawning.

During summers without severe heat waves (*i.e.*, 2001 and 2004), CV spring-run Chinook salmon can utilize Butte Creek in large numbers without significant pre-spawn mortality. In 2001, there were 10,887 spring-run Chinook upstream of Centerville

Powerhouse and 7,425 downstream, but only 193 pre-spawn mortalities were identified in limited surveys between June 14 and September 6 (Ward *et al.* 2004c). In 2004 there were 5,572 Chinook upstream of the powerhouse, and 4,649 downstream, with only 418 pre-spawn mortalities (Ward *et al.* 2005). Ward *et al.* (2005) concluded that the pre-spawn mortalities likely were attributable to natural attrition.

Studies by CDFG (Ward *et al.* 2004c, Ward *et al.* 2005) have suggested that pre-spawning mortality is limited during summers when average daily water temperatures at Quartz Bowl (1 mile downstream of LCDD) do not exceed 19.4 °C for extended periods of time (as in 2001 and 2004). Significant pre-spawning mortality was triggered in 2002 and 2003 when mean daily temperatures exceeded 19.4 °C for 16 days and 11 days, respectively. Based on CDFG's air temperature frequency assessments, this seems most likely to occur when air temperatures fall into the upper 10 percent years over the period of record. In response to the 2002 and 2003 pre-spawning mortalities, and as part of the proposed action, PG&E, with the cooperation of CDFG, NMFS, and USFWS, develops an Annual Operating Plan that includes weather forecasting and contingency planning to help predict extreme heat events, and to make operational adjustments that maximize the delivery of cold water to anadromous habitat in Butte Creek. In 2005, weather forecasts showed a prolonged heat event was likely to occur during mid-July. Simultaneously, water temperatures in Butte Creek were showing an upward trajectory similar to the heat event that occurred in 2003. In response, PG&E reduced flows from Round Valley Reservoir, and increased Philbrook Reservoir releases to 30 cfs to deliver a pulse of cold water to Butte Creek. Water temperature data collected by CDFG indicate that the pulse flow stopped the upward trajectory, and caused water temperatures to plateau before reaching the levels that triggered the adult mortalities seen in 2003 (Paul Ward, CDFG, pers. comm., 2006)

Ward and Keir (1999) identify thermal criteria from several sources to evaluate summer water temperatures for suitability of CV spring-run Chinook salmon (Table 4). Based on these criteria, temperatures in Butte Creek regularly exceed the published thermal criterion, which appears in conflict with the large recent returns of CV spring-run Chinook salmon. Information relating to the unique temperature tolerances of Butte Creek spring-run Chinook salmon relating to holding, rearing, fish distribution, survival, and fecundity is not available. Lindley *et al.* (2004) suggest, based on the ability of the Butte Creek population to regularly survive temperatures above the reported incipient lethal limit, that this population may be genetically adapted to warmer temperatures than other CV spring-run Chinook salmon stocks.

NMFS expects that an annual operating plan will reduce the frequency of years that result in water temperatures exceeding 19.4 °C. Additionally, water temperature monitoring and modeling in progress for the project relicensing will allow quantification of the extent that transport of water through the Butte Canal enhances habitat conditions for over-summering adult and juvenile Chinook by reducing temperatures in Butte Creek. This information will be used to make adjustments to project flows to maximize the survival and spawning success of CV spring-run Chinook salmon in the action area.

The diversion of water from the WBFR accounts for approximately 40 percent of the summer flows in Butte Creek, as measured immediately above the LCDD. This, together with other diversion actions, and reduced transit times, results in a greater quantity of cold water habitat for CV spring-run Chinook salmon than would occur without the proposed action. As currently proposed, project operations will enhance habitat conditions for CV spring-run Chinook salmon in Butte Creek when added to the *Environmental Baseline* scenario that analyzed the projected status of the species and critical habitat assuming the proposed continuing action would not longer be authorized or carried out.

Table 4. Thermal criteria used to evaluate summer water temperatures for suitability of CV spring-run Chinook salmon. Criteria from Berman (1990; as cited in USFWS 1996), Armour (1991), USBR (1991), and CDFG (1998). Table adapted from Ward and Keir (1999).

Life Stage	Timing	Mean Daily Water Temperature	Anticipated Response
Adult Holding	July 1 to September 14	<16 °C	Optimum survival
		>16 °C	Some mortality and infertility
		>19 °C	No successful spawning
		>27 °C	Lethal
Spawning and Incubation	September 15 to September 30	<14 °C	8 percent mortality at 24 days
		>14, <16 °C	15-25 percent mortality at 20 days
		>16-<17	50-80 percent mortality at 15 days
		>17 °C	100 percent mortality at 7-12 days

d. *Potential Effects on Transport of Gravel and Large Woody Debris*

Project reservoirs and diversions normally have the potential to alter the transport of gravel and large woody debris (LWD), which often are important components of instream habitat. However, because the area behind the Butte Creek Diversion Dam and LCDD are filled in with sediment, the structures currently do not interfere with sediment transport in Butte Creek. The limited availability of gravel upstream of Centerville Powerhouse is not related to operation of the project, but reflects the natural geomorphology of Butte Creek. Williams *et al.* (2002) described the 5.65-mile reach of Butte Creek between LCDD and the Helltown Bridge as primarily a sediment transport zone, in which fluvial processes are dominated by the bedrock channel and the steep gradient, and where gravel deposits suitable for spawning occur only at the tails of pools or in the lee of large obstructions.

The degree to which LWD transport has been modified by project structures, operations, and maintenance has not been quantitatively evaluated. However, since Butte Creek Diversion Dam and LCDD have relatively low trap efficiency and the diversions at these two dams are curtailed or ceased during large storms (reducing the likelihood of collecting debris on the diversion trash racks), it is likely that these structures have only a minor effect on the transport of LWD. In addition, during periods of high stream flows when most LWD transport occurs, PG&E reduces the amount of flow diverted to avoid overtopping canals and flumes.

e. *Potential for Fish Stranding or Displacement from Rapid Changes in Flow Related to Project Operations and Maintenance*

The project has the potential to strand juvenile CV spring-run Chinook salmon downstream of diversions if canals are brought back on line too rapidly after planned or forced outages. Fish stranding can also occur as a result of reducing canal flows during storm events to prevent potential overtopping and later bringing canal flows back on line too rapidly. Both scheduled and forced outages in the Lower Centerville Canal can potentially cause fish stranding in the reach of Butte Creek between LCDD and Centerville Powerhouse. Flow changes associated with restoring canal operations after scheduled or forced outages may occur 3-8 times per year. In the case of scheduled and forced outages occurring in the Hendricks/Toadtown Canal, a sudden drop in canal flow could potentially cause a sudden reduction in flows below LCDD or possibly in the reach below Centerville Powerhouse depending on spill conditions at LCDD. To avoid or minimize stranding, PG&E proposes that any reduction in stage during these events will be limited to approximately 0.1 foot per hour, based on the hydraulic data developed by USFWS (2003). This ramping rate also will be used when returning flow to Lower Centerville Canal after flow reductions to prevent canal damage during storm events.

The potential for stranding is related to several factors, including channel morphology, substrate type, species and life stage presence and abundance, time of year, river stage, and the magnitude, rate, and frequency of flow fluctuations (Hunter 1992). The vulnerability of fish to stranding is a function of their size and their behavioral response to changing flows, which depends on the type of species, water temperature, time of year, and time of day. Newly emerged fry appear to be most vulnerable to stranding because of their limited swimming ability, their tendency to use the substrate as cover, and their preference for shallow river margins. As juveniles grow, they move to deeper, higher-velocity water associated with main channel habitats where they are less susceptible to stranding.

Field and laboratory observations indicate that juvenile salmonids are most susceptible to stranding when water temperatures drop below 4.0–8.0 °C (39–46 °F), because juveniles become relatively inactive and generally seek cover at these temperatures (Chapman and Bjornn 1969). For example, Bradford *et al.* (1995) found that relatively high proportions of juvenile coho salmon and rainbow trout were stranded on simulated gravel bars and pools when subjected to rapid flow reductions during the winter at temperatures of 3.5–4.0 °C (38–39 °F). Significantly more juvenile salmon and trout were stranded during the day than at night because they concealed themselves in the substrate during the day and left the substrate at night.

In a similar experiment with juvenile Chinook salmon during the spring, Bradford (1997) found that gravel bar stranding occurred on bars with a streambank gradient of approximately 4.5 percent at 6°C compared to about 0.5 percent during his 12 °C trials. In these experiments, the time of day had no significant effect on stranding rates. However, field observations suggest that Chinook salmon fry may be more susceptible to stranding during the day, whereas steelhead fry may be more susceptible at night (Olson and Metzgar 1987, Hunter 1992). Bradford *et al.* (1995) and Bradford (1997) found that flow ramping rate affected the incidence of stranding. Under winter conditions, significantly more coho salmon and rainbow trout juveniles were stranded on simulated gravel bars and side channels at ramping rates of 30 centimeters per hour (cm/h) (11.8 inches per hour) than at 6 cm/h (2.4 inches per hour). Similar results were reported for juvenile Chinook salmon in simulated side channels during the fall (Bradford *et al.* 1995). Based on a field investigation of stranding of Chinook salmon and steelhead fry in the Sultan River, Washington, Olson and Metzgar (1987) recommended a schedule of variable ramping rates ranging from 1 to 6 inches per hour (2.5 to 15.0 cm/h) depending on flow range, season, and time of day.

River channel configuration and the slopes of gravel bars can also affect the incidence of stranding. A river channel with many side channels, potholes, and low gradient bars will have a much greater incidence of stranding than a river confined to a single channel with steep banks. Stranding of Chinook salmon and steelhead juveniles has been reported to increase on bars with slopes less than 4 percent (Hunter 1992, Bradford *et al.* 1995).

Fish size can greatly influence mortality rates resulting from stranding. In one study, smaller Chinook salmon (35-45 mm) suffered greater mortality due to down ramping than did larger individuals in the system, and nearly all observed mortalities were of small fish 25-50 mm (Bauersfield 1978). Olson and Metzgar (1987) found stranded salmon to be between 30 and 48 mm.

In the first 2.5-3.0 miles of stream below LCDD, the stream channel is relatively narrow and is characterized by alternating deep pools, with large boulder and bedrock substrates. The gradient is steep, and only small quantities of gravel occur in this stream section. Below this point, the channel begins to widen, and lower gradient sections of stream alternate with steeper gradient sections. Gravel is most abundant in the lower 3.5 miles of this stream section down to Centerville Powerhouse. The stream section in the vicinity of the Old Helltown site (*i.e.*, approximately 1.2 miles above Centerville Powerhouse) is relatively wide, with shallow low velocity sections that contain some of the larger low gradient gravel bars in this reach. The Helltown area, with its relatively high spawning use (USFWS 2003), likely represents the area of highest stranding potential in the entire reach below LCDD. This area is also the location for three instream flow study sites used by the USFWS to evaluate flow-habitat relationships for CV spring-run Chinook salmon spawning (USFWS 2003).

Historically, project canal and powerhouse outages were scheduled during the summer and fall, after flow had dropped off, to minimize hydroelectric power generation loss. However, since 2004, PG&E has scheduled outages during the winter/early spring months. This change in operations was made to avoid potential impacts to over-summering and spawning spring-run Chinook salmon from decreased flows and potentially increased water temperatures. Current operation practices are described in PG&E's 2005 Project Operations and Maintenance Plan.

To protect juvenile salmonids and minimize the risk of stranding, beginning in 2003 PG&E and the resource agencies developed interim ramping rates to be used when returning water conveyance facilities to service following forced or scheduled outages. The interim ramping rates were set at 5 cfs/hr when streamflows in Butte Creek were less than 200 cfs, and 25 cfs/hr when Butte Creek flows were in excess of 200 cfs. These ramping rates were used by PG&E to bring Centerville Canal back in service in December 2003 and January 2004.

To confirm whether the interim ramping rates selected by PG&E and the resource agencies were sufficiently protective of juvenile salmonids, PG&E evaluated hydraulic information developed by USFWS (2003). This ramping rate evaluation was designed to achieve the following two objectives: 1) to identify a threshold flow whereby background flows in excess of this amount would not require any ramping, and 2) to develop a ramping schedule that uses 0.1 ft/hr as the maximum rate of change in water surface elevation to protect small juvenile salmonids that can occur during scheduled and forced outages. The 0.1 ft/hr ramping rate is supported by the literature and is the rate adopted by the resource agencies and PG&E for the Battle Creek (FERC No. 1121) Salmon and Steelhead Restoration Project.

To conduct the threshold flow and ramping rate evaluation, PG&E obtained the USFWS (2003) 2D hydraulic and habitat models (RIVER2D, Steffler and Blackburn 2001) for the three instream flow study sites located in the vicinity of Helltown Bridge, upstream of Centerville Powerhouse. The stream morphology and heavy spawning use in the Helltown Bridge area makes these three sites well-suited for evaluating stranding potential. The threshold flow analysis looked at model outputs for changes in wetted area versus flow within the 20-450 cfs flow range. The wetted area output information was then converted to an average wetted width, and the change in wetted width ("stranding width") was calculated to obtain a better visual interpretation of stranding potential for each site. As flows decline below 450 cfs, the stranding width increases in magnitude. Although the data indicate that no clear threshold flow exists for the three study sites combined, they do show the relative differences in stranding potential between the three sites. For example, this analysis shows that the stranding potential at the Above Helltown 1 site is much less than the other two sites. The computed relationship between stranding width and streamflow at the Above Helltown 1 site suggests that stranding width increases to about 19 ft (9.5 ft on each bank) as flows are reduced from 450 to 20 cfs. This is in contrast to the Above Helltown 2 and Helltown Bridge sites where stranding width increases to approximately 60 ft (30 ft on each bank) as flows are reduced from 450 cfs to 20 cfs.

Because this analysis indicated that no threshold flow could be identified, the next level of assessment focused on developing ramping schedules for the three study sites using the full range of flows available in the 2-D hydraulic model. This analysis consisted of first determining the drop in water surface elevation associated with different flow levels simulated in model runs at each site. The next step included identifying a range of flows where ramping could occur without exceeding the 0.1 ft/hour ramping rate objective. The site Above Helltown 1 had the lowest stranding potential and also allowed for the most aggressive ramping rates according to the analysis. Ramping rate schedules for the Above Helltown 2 and Above Helltown Bridge study sites were very similar and indicate a need for slower ramping to meet the 0.1 ft/hour objective. A ramping rate schedule that incorporates the analysis results for all study sites combined was also developed to address overlapping ramping rates for similar stream flows.

The results of this analysis indicate the interim ramping rates established in 2003 (25 cfs/hr at stream flows >200 cfs and 5 cfs/hr at stream flows <200 cfs) are more conservative than necessary to protect against fry stranding in Butte Creek. Therefore, NMFS believes that the proposed ramping rate schedule as described in the 2005 Project Operations and Maintenance Plan is unlikely to strand anadromous fish downstream of LCDD during normal operations and maintenance.

Additional instream flow studies that will be conducted during project relicensing may provide additional quantification of fry stranding potential in Butte Creek. One objective of the habitat mapping study element for the lower Butte Creek instream flow study will be to identify study sites below LCDD that could potentially pose higher risks for fish stranding than those evaluated above for the USFWS (2003) study sites in the vicinity of Helltown Bridge. If higher stranding risk sites are identified, PG&E proposes to develop a hydraulic model for these sites and potentially revise the ramping rate schedule.

f. *Potential Effects on Water Quality from the Operation of Powerhouses and other Facilities Containing Hazardous Materials*

Project powerhouses have the potential to introduce toxic substances or contaminants into surface waters. However, because project facilities largely are unmanned (*i.e.*, remotely operated), are equipped with contained sanitary facilities, and are run in accordance with spill prevention control and countermeasure plans, it is unlikely that they contribute contaminants at levels that adversely affect CV spring-run Chinook salmon.

A variety of herbicides are intermittently used adjacent to the Butte, Hendricks/Toadtown, and Lower Centerville canals for weed control. Little or no herbicide is used along the Upper Centerville Canal. When a canal is scheduled for treatment, one or more applications of herbicide may occur. For example, a pre-emergent application may be conducted in early spring prior to germination and a foliar application may be conducted later in that same year, if needed. Each of these applications is carefully administered so that no herbicide is sprayed directly into the water or on a surface that can come in contact with water. A third application, of an herbicide approved for aquatic use (*e.g.*, Direx), may be applied along the bank side of the canal during an outage to control plant growth near the water line. Herbicides are only applied by licensed qualified herbicide applicators. Herbicides treatments typically are localized spot applications and do not occur throughout the project area.

The herbicides used for weed control along the Butte, Hendricks/Toadtown, and Lower Centerville canal include: Karmex (*Diuron*), Round-Up Pro (*Isopropylamine salt of glyphosate*), Accord (*Glyphosate*), Telar (*Chlorsulfuron*), Garlon 4 (*Triclopyr*), Oust (*Sulfometuron methyl*), and Direx (*Diuron*). Additionally, methylated seed oil (MSO) and Hasten modified vegetable oil were also used as additives to some herbicides as surfactants. The herbicides used the most are the two products that use Diuron as an active ingredient, Karmex and Direx. Karmex and Direx are used primarily outside the berm of the canal. In certain settings, these herbicides are now listed as groundwater contaminants. PG&E is not required by law or regulation to eliminate or restrict the use of these chemicals in the action area.

The ecotoxicology for selected fish species for each herbicide used adjacent to the canal was evaluated by PG&E. Based on the amount of herbicides used, the relatively large spatial area over which a small amount of the herbicides are applied (*i.e.*, 30 miles of canals), the methods of application that limit the area of exposure and avoid direct application to water, and the high volume of water in the canal at the time of application, the amount of herbicidal active ingredient entering project waters should be very low and the dilution rate high. Consequently, the potential effects of herbicide use on sensitive life-history stages (*i.e.*, holding and spawning adults, eggs, larvae and fry) of spring-run Chinook in the action area are expected to be minimal, and not result in the injury or death of individuals. Likewise, and for similar reasons, NMFS expects the potential effects of common adjuvants and surfactants will be minimal, and not result in the injury or death of individuals.

Additional data on water quality will be collected at project facilities and analyzed during the project relicensing process. As part of the water quality study to be conducted for relicensing, the active ingredient(s), and toxic adjuvants and surfactants of any herbicides proposed for use near the canals will be included in the water quality chemical analysis at sites downstream of the herbicide application site for the sampling period occurring just after scheduled herbicide application.

g. *Potential Effects from Sediment and Turbidity Caused by Project Operation and Maintenance*

Routine project operation and maintenance activities have the potential to release sediment and increase turbidity in Butte Creek. Operation of Centerville Powerhouse occasionally requires the use of the spillway channel from the penstock header box. In addition, canal outages resulting from an unscheduled system trip, or maintenance activities (*i.e.*, instream work, forebay dredging, and canal and powerhouse work) have the potential to affect water quality downstream of Centerville Powerhouse. In particular, water quality may be affected when the canal is returned to service, and ramping flows potentially re-suspend fine sediment and create turbid conditions.

(1) ***Operations.*** Limited turbidity data has been collected for Butte Creek in the action area. From September 2004, to January 24, 2005, maximum turbidity levels measured during standard operations ranged from 1.1 to 23 NTU, with background turbidity ranging from 0.3 to 1.8 NTUs. The highest NTU measured was 44 NTUs, during a high-flow event. Based on data collected in 2004 and 2005, operations-related turbidity events appear to occur from one to four times per year. PG&E has recorded operations-related turbidity during the months of September, October, December, and January.

Based on the maximum reported operations-related turbidity (*i.e.*, 23 NTUs on January 24, 2005) the literature indicates a range potential impacts from no effects to minor physiological, sublethal effects. Based on studies by Gregory and Northcote (1993), turbidity is expected to cause temporary behavior changes. PG&E (2005) used Newcombe's (2003) severity of effects indices and found that the majority of events cause no effects, while some infrequent events that occur for over 7 days may cause sublethal effects such as short-term reductions in feeding rates in juveniles to minor physiological stress in eggs and larvae (*i.e.*, fish still possessing a yolk sac), if present, including an increased rate of coughing and respiration rate in larvae. These models present an estimate of the effects of turbidity on fish, but do not take into account positive effects associated with higher turbidity including short-term increased feeding rates due to increase prey availability, or other negative effects such as increased physiological stress.

Most potential effects to CV spring-run Chinook salmon likely will be limited to temporary behavioral responses. Based on the timing of most events (*i.e.*, during winter months when adults are not in the system and juveniles are outmigrating), the infrequency of occurrence (*i.e.*, approximately four times per year), brief duration (*i.e.*, hours), and localized nature of such events, the impacts to anadromous fish are expected to be minor and individual fish are not expected to be killed or injured.

(2) ***Maintenance.*** Maintenance-related turbidity events recorded by PG&E occur from three to eight times per year. PG&E has recorded operations-related turbidity during the months of April, May, July, August, September, December, and January. The highest maintenance-related turbidity level measured in Butte Creek occurred in February 2004 during a spill gate release at LCDD. The turbidity measured 30 NTUs above background levels; maximum turbidity was measured at 47.5 NTUs. The second highest project-related turbidity level occurred in August 1998 during a bank stabilization project. The turbidity measured 39.5 NTUs above background levels; maximum turbidity was measured at 40 NTUs. The most common of project-related turbidity events are caused by maintenance in the canals, particularly the Lower Centerville Canal. Maximum measured turbidity levels associated with maintaining and restarting project canals range from 2 to 4 NTUs; background turbidities range from 0.6 to 2.1 NTUs. For example, in 2003, the maximum turbidity measured after cleaning up a slide into the Lower Centerville canal was 3 NTUs; background turbidity was 1.6 NTUs.

Project roads also have the potential to introduce sediment and increase turbidity in Butte Creek. Roads are maintained to minimize the effects and potential for erosion, and sediment transport stream channels and canals. The location and condition of project-related roads and road features will be inventoried as part of project relicensing studies. Based on these evaluations, measures will be taken to minimized road-related sediment transport where appropriate.

NMFS expects that maintenance-related turbidity events will result in impacts to CV spring-run Chinook salmon that are similar to those previously described for operations. Potential impacts are expected to range from no effects to minor physiological, sublethal effects. Most potential effects to CV spring-run Chinook salmon will likely be limited to temporary behavioral responses. Based on the timing most events, the infrequency of occurrence, brief duration, and localized nature of such events, the impacts to anadromous fish are expected to be minor and individual fish are not expected to be killed or injured.

3. Interrelated or Interdependent Actions

The only potential interrelated and interdependent actions to the proposed project involves the facilitation of recreational activities. The project's diversion of water from the WBFR may provide conditions that enhance recreational opportunities for "tubing" (*i.e.*, floating down the creek on top of an inner tube) and swimming in Butte Creek downstream of Centerville Powerhouse. These recreational activities occur in areas supporting holding habitat for Chinook.

Campbell and Moyle (1992) conducted three rafting experiments in Butte Creek in 1990 and ten experiments in Deer Creek in 1991. The results of the study indicated rafting had a statistically significant effect on the movement of adult spring-run Chinook salmon (sign test, p-value 0.003, n = 13). In 12 of 13 experiments, more upstream/downstream movement occurred during the rafting period than the control period. However, the median number of movements per fish per 20 minutes was 1.1 (*i.e.*, crossing mid pool from downstream to upstream, or vice versa) when rafting occurred and 0.2 when no rafting occurred. Also, the distance of each movement within a pool habitat was small. Campbell and Moyle (1992) suggest "[r]afting could be an important source of stress to salmon if it is a common activity in their summer habitat." Although recreational use has not been quantified, numerous inner-tubing groups (*i.e.*, as many as 10 groups per weekend day) are known to float this reach during summer months.

Thresholds related to these movements have not been quantified to determine stress levels. It is unknown therefore whether the movements described in the study elicits a stress response in CV spring-run Chinook or has a significant biological effect such as injury, death, or reduced fecundity among females. NMFS expects that the repeated frequency and intensity of these activities is likely to injure or kill some holding adults, and may result in reductions in fecundity. Although not all fish will be affected, an unquantifiable number of fish will affected when water temperatures are greater than 16 °C. As part of the DeSabla-Centerville relicensing process, a number of studies will describe and assess the impact of recreation activities on project resources, lands, and waters.

4. Impacts to Critical Habitat

Critical habitat for CV spring-run Chinook salmon is defined as specific areas that contain the primary constituent elements (PCE) and physical habitat elements essential to the conservation of the species. PCEs within the action area include freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development; freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; and freshwater migration corridors that are free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility, survival and food supply.

The proposed action is expected to result in modifications to the primary constituent elements of freshwater spawning, and rearing habitat. Essential features of primary constituent elements that may be affected by the action include adequate water temperatures, flows, and pool and riffle depths for adult upstream migration and summer holding; adequate flow and water temperatures for adult spawning; adequate flows, and water temperatures for egg incubation and emergence; and adequate water temperatures, flow, refugia, and food production for juvenile rearing and emigration.

Based on the best available information, the proposed action will maintain the quantity and quality of existing critical habitat. The project increases the conservation value of critical habitat when added to the environmental baseline scenario that analyzed the projected status of critical habitat assuming the proposed continuing action would no longer be authorized or carried out. NMFS expects that the proposed action will continue to provide habitat conditions capable of supporting large populations of CV spring-run Chinook salmon throughout proposed 50-year license period. The conservation value for designated critical habitat within the action area is expected to remain high. Therefore, we do not expect project-related impacts to result in an adverse change to the conservation value of critical habitat for the ESU.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Ongoing agricultural activities likely will continue to cause entrainment into diversions, adversely affect water quality, fragment habitat availability, and thus result in cumulative effects to CV spring-run Chinook salmon.

Non-federal actions that are reasonably certain to occur include the continued operation of the fish ladder and fish screen at the Parrott-Phelan Diversion Dam, maintenance of rural roads, logging on commercial timberlands in the Butte Creek watershed upstream of the anadromous fish habitat, recreational gold mining upstream of the anadromous fish habitat, and additional rural residential construction and associated unscreened domestic riparian diversions.

The operation of the fish ladder at Parrott-Phelan Diversion Dam provides for a higher rate of successful upstream passage of adult CV spring-run Chinook salmon, whereas the fish screen increases the chances of survival of downstream juvenile Chinook. Timber harvesting, gold mining, and maintenance of rural roads each have the potential to adversely affect water quality in Butte Creek. Timber harvesting and runoff from rural roads unrelated to the project have the potential to increase turbidity and sediment delivery to Butte Creek during the rainy season, whereas recreational gold mining has the potential to increase turbidity in Butte Creek during the summer. Unscreened domestic water diversions have the potential to entrain fry and juvenile Chinook.

Although the exact nature and extent of the effects of the foregoing activities on CV spring-run Chinook salmon are not known, the predominant potential effects of these activities relate to water quality and turbidity. Currently available data suggest that water quality conditions, including turbidity levels, generally are favorable for fish in the action area. The current status of the species in Butte Creek suggests that the adverse cumulative effect of these activities is likely to be minimal.

VII. INTEGRATION AND SYNTHESIS

The quantity and quality of CV spring-run Chinook salmon habitat is affected by the DeSabla-Centerville project. In general, the proposed action of issuing a 50-year license for the continued operation of the project will maintain or improve holding and spawning habitat availability and the conservation value of critical habitat when added to existing operations, and would increase availability and conservation value in contrast to without project conditions.

The physical aspects of project facilities, such as LCDD and the Centerville Powerhouse, are not expected have any significant effects likely to result in injury or death to CV spring-run Chinook salmon. The presence of the LCDD, and the effects of the flow reduction at into the Centerville Canal is not expected to result in any population-level effects because in most years no fish migrate upstream from the Quartz Bowl Pool, and in years that fish do access this reach, there is a sufficient quantity and quality of holding and spawning habitat to support the number of fish that may be present. Likewise, since these facilities do not appear to be reducing the quantity or the quality of the habitat's primary constituent elements, including freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors, the physical elements of the project facilities are not likely to reduce the conservation value of the critical habitat.

There is a potential for water quality impacts from contaminants and turbidity to adversely affect CV spring-run Chinook salmon. Because project facilities are frequently inspected and remotely operated, are equipped with contained sanitary facilities, and are run in accordance with spill prevention control and countermeasure plans, it is unlikely that they contribute to water quality effects capable of causing population-level consequences. Herbicide use also could affect CV spring-run Chinook salmon. However, based on the amount of herbicides used, the relatively large spatial area over which a small amount of the herbicides are applied (*i.e.*, 30 miles of canals), the methods of application that limit the area of exposure and avoid direct application to water, and the high volume of water in the canal at the time of application, the amount of herbicidal active ingredient entering project waters should be very low and the dilution rate high. Consequently, the effects of herbicides are not likely to result in any population-level effects.

Routine project operation and maintenance activities have the potential to release sediment and increase turbidity in Butte Creek. Potential impacts are expected to range from no effects to minor physiological, sublethal effects. Most potential effects to CV spring-run Chinook salmon will likely be limited to temporary behavioral responses. Based on the timing most events (*i.e.*, winter months when background turbidity is already elevated), the infrequency of occurrence (*i.e.*, between one and eight times per year), brief duration (*i.e.*, hours as opposed to days), and localized nature of such events, the impacts to anadromous fish are expected to be minor and not result in any population-level impacts.

The proposed flow regime, along with the Annual Operations and Maintenance Plans are expected to maintain, or improve the quality and quantity of holding, spawning, rearing, and migration habitat, available to Butte Creek spring-run Chinook salmon. The project creates a substantially higher quantity and quality of holding and spawning habitat, and is able to support a substantially higher number of fish, when added to without-project conditions. This primarily is due to the import of cold water from the WBFR, but also due to the water distribution and deliveries that occur under the proposed action. High air and water temperatures within the project area can result in water temperatures that can kill or injure adult salmon. The most significant mortality events appear to be related to weather conditions that were in the hottest 10 percent of days on record. They also were density dependant situations where fish that were holding under very high density conditions died when water temperatures triggered the outbreak of pathogens. Not all fish in Butte Creek were affected equally. In pools with low to moderate fish densities, mortality rates were substantially lowerer. Following the most recent fish mortalities, enough fish survived to overutilize the spawning habitat in the areas where mortalities were highest, and underutilize spawning habitat where mortality was comparatively lower. In other years where extreme heat events did not occur, or were offset by the contingency measures outlined in Appendix A of the 2005 Project Operations and Maintenance Plan, mortalities were much lower, and most likely related to natural attrition, and outside of the project's control.

Regardless of these recent circumstances, the potential for climate change to increase Butte Creek water temperatures appears to pose a significant threat to CV spring-run Chinook salmon. If climate change progresses according to the most recent predictions, the frequency, magnitude, and duration of extreme hot weather events likely will increase and result in more frequent or extreme pre-spawning mortality events. The implementation of Annual Operations and Maintenance Plans and the implementation of contingency actions would certainly reduce the effects on Butte Creek water temperatures to some degree. However, additional modifications to project facilities may be required to maintain water temperatures suitable for long-term survival of this population. The ongoing PG&E relicensing studies are analyzing system-wide water temperatures and developing a comprehensive model for use in future project operations, and Annual Operations Plans. The model also will be used to determine if facility modifications can be made to maintain or improve water temperatures for CV spring-run Chinook salmon in Butte Creek.

These factors, and the conclusions of Lindley *et al.* (2006) suggest that the proposed action to issue a license to operate the project for another 50 years will not affect the long-term survival and viability of the Butte Creek population of spring-run Chinook salmon, or the viability of the ESU. Additionally, it appears that the proposed action will maintain or improve the conservation value of the relevant primary constituent elements of critical habitat.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of CV spring-run Chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that FERC's proposal to issue a new license for the PG&E DeSabla-Centerville project (FERC No. 803), as proposed, is not likely to jeopardize the continued existence of CV spring-run Chinook salmon, and is not likely to destroy or adversely modify their designated critical habitat.

IX. INCIDENTAL TAKE STATEMENT

Because the proposed action is likely to result in the incidental taking of listed species, NMFS has included an incidental take statement pursuant to section 7(b)(4) of the ESA. However, because this is an early consultation on the prospective action, this incidental take statement does not eliminate FERC or PG&E's liability under the taking prohibitions of section 9 of the ESA. Instead, this statement provides your agency and the applicant with foreknowledge of the terms and conditions that will be required if the proposed action is implemented. These reasonable and prudent measures and the implementing terms and conditions become effective only after NMFS confirms the preliminary biological opinion as a final biological opinion on the proposed action.

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by FERC so that they become binding conditions of any grant or permit, as appropriate, for the exemption in section 7(o)(2) to apply. FERC has a continuing duty to regulate the activity covered by this incidental take statement. If FERC: (1) fails to assume and implement the terms and conditions, or (2) fails to require the contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, FERC must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

A. Amount or Extent of Take

NMFS anticipates incidental take CV spring-run Chinook salmon, through operations and maintenance impacts, and habitat modification and loss within the action area. Specifically, NMFS anticipates that all freshwater life stages of CV spring-run Chinook salmon may be injured, killed, or harmed as a result of the proposed action.

NMFS cannot, using the best available information, quantify the anticipated incidental take of individual CV spring-run Chinook salmon, because of the uncertainty associated with annual variations in adult abundance, the timing of migration, holding and spawning distribution, and water temperatures. However, it is possible to describe the conditions that will lead to the take. Accordingly, NMFS is quantifying incidental take of CV spring-run Chinook salmon in terms associated with the extent of habitat operations and maintenance activities that: (1) result in measurable losses of habitat availability, (2) cause behavioral modifications that result in injury or death. The following level of incidental take from project activities is anticipated:

1. Take in the form of harm to freshwater life stages of CV spring-run Chinook salmon from the loss of holding, spawning, and rearing habitat between the LCDD and the Centerville Powerhouse associated with maintaining a minimum instream flow downstream from the LCDD of 40 cfs.

2. Take in the form of injury and death for project-related temperature changes between LCDD and Centerville Canal, caused by maintaining a minimum instream flow below LCDD of 40 cfs.

3. Take in the form of harm or injury for fish that encounter LCDD during upstream migration, and are unable to access potentially historic upstream habitat. This level is expected to be less than one percent of the adult population.

4. Take in the form of injury or death is expected from project operations and maintenance flow changes, for rates that are no less than 0.1 foot per hour that strand or isolate juvenile CV spring-run Chinook salmon.

Anticipated incidental take may be exceeded if project activities exceed the criteria described above, or if the project is not implemented as described in the DeSabla-Centerville project (FERC No. 803) Biological Assessment for CV spring-run Chinook salmon (2005).

B. Effect of the Take

NMFS has determined that the above level of take is not likely to jeopardize the continued existence CV spring-run Chinook salmon. The effect of this action will consist of loss of a small amount of holding and spawning habitat above the Centerville Powerhouse, and a significant increase in holding and spawning habitat below the Centerville Powerhouse. Other effects consist of infrequent, low levels of death, injury or behavior modifications related to flow changes and project-related increases in water turbidity.

C. Reasonable and Prudent Measures

NMFS has determined that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of listed anadromous salmonids.

1. Measures shall be taken to minimize injury and mortality from project construction, operations, and maintenance.

2. Measures shall be taken to maintain, monitor, and adaptively manage all conservation measures throughout the life of the project to ensure their effectiveness.

D. Terms and Conditions

1. **Measures shall be taken to minimize injury and mortality from project construction, operations, and maintenance.**

a. FERC shall require PG&E to continue to provide cold water as available from the Project facilities to Butte Creek below the Centerville Powerhouse to support the long-term survival of CV spring-run Chinook salmon in habitat that is currently used for holding and spawning, while providing flows of at least 40 cfs during the holding and spawning period of CV spring-run Chinook salmon in the reach upstream from the Centerville Powerhouse.

b. As part of the relicensing of the Project, FERC shall require PG&E to study the feasibility and effectiveness of reducing the thermal loading in DeSabla Forebay during the months of July and August with a goal of reducing thermal loading by 50 percent.

c. Based on the results of the study regarding the potential for reducing the thermal loading in DeSabla Forebay, FERC shall require PG&E to develop a DeSabla Forebay Water Temperature Improvement Plan within 2 years of issuing the license.

d. FERC shall require PG&E to implement measures recommended in the DeSabla Forebay Water Temperature Improvement Plan as soon as practicable after approval of the plan.

2. **Measures shall be taken to maintain, monitor, and adaptively manage all project elements and conservation measures throughout the life of the project to ensure their effectiveness.**

a. FERC shall require PG&E to maintain and improve project facilities in good working condition for the duration of the license to minimize the potential for facility failures to cause adverse flow related impacts to CV spring-run Chinook salmon. To ensure this occurs, FERC shall require PG&E to develop a long-term facility monitoring, maintenance, and refurbishment plan, in consultation with NMFS and CDFG, within one year of the issuance of the new license.

b. Prior to issuance of the new license, FERC shall require PG&E to annually prepare an operations plan with approval from NMFS and CDFG. The primary goal of the Annual Operations Plan should be to seek to provide cold water for holding and spawning CV spring-run Chinook salmon in the reaches of Butte Creek upstream and downstream from the Centerville Powerhouse. The plan also shall consider the feasibility of increasing spawning habitat availability by increasing flows in between the Centerville Diversion Dam and the Centerville Powerhouse during the spawning and egg incubation period (*i.e.*, late-September to February), while balancing power production. The plan also may consider modifications to facility operations and maintenance necessary to avoid, minimize, or improve project-related impacts to CV spring-run Chinook salmon. Within one year of issuance of the new license, FERC shall require PG&E to prepare a long-term operations plan for the duration of the license period. The long-term operations plan shall have the same goal described above and shall be approved by NMFS and CDFG.

c. Within one year of issuance of the new license, FERC shall require PG&E, in cooperation with NMFS and CDFG, to develop and implement a long-term upper Butte Creek CV spring-run Chinook salmon monitoring plan, which shall consist of an annual snorkel survey to monitor adult migration and abundance, an annual pre-spawning mortality survey, and an annual carcass survey to monitor spawning and adult abundance. The annual carcass survey may be discontinued if PG&E, NMFS and CDFG agree that the monitoring has established a sufficient correlation between the snorkel survey data and the carcass survey data. The plan also shall provide for the consideration of juvenile emergence and outmigration monitoring in the year following either a drought year or a year with extreme hot weather conditions. The emergence and outmigration monitoring may be discontinued if PG&E, NMFS and CDFG agree that the monitoring has established a sufficient indication of the effect of drought or extreme hot weather on the subsequent brood year.

d. Within one year of approval of the long-term operations plan and the long-term upper Butte Creek CV spring-run Chinook salmon monitoring plan, FERC shall require PG&E to develop annual reports summarizing (1) the prior year's implementation of the long-term operations plan and the effects of project operations on CV spring-run Chinook salmon and their habitat, and (2) the results of the prior year's long-term Butte Creek spring-run CV Chinook salmon monitoring.

e. Within one year of issuance of the new license, FERC shall require PG&E to install and maintain streamflow and water temperature gauges at the following locations: (1) below Lower Centerville Diversion Dam; and (2) in the Centerville Powerhouse tailrace. PG&E shall also install and maintain a water temperature gauge immediately upstream of the Centerville Powerhouse tailrace. The gauges shall be capable of recording data in at least hourly increments. PG&E shall provide NMFS and CDFG with daily reports of the data from the gauges. In addition, PG&E shall provide NMFS and CDFG with reasonable access to such data on a more frequent basis upon request.

Reports and notifications required by these terms and conditions shall be submitted to:

Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300

Sacramento California 95814-4706
FAX: (916) 930-3629
Phone: (916) 930-3600

X. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These conservation recommendations include discretionary measures that FERC can implement to avoid or minimize adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. NMFS provides the following conservation recommendations that would avoid or reduce adverse impacts to listed salmonids:

1. Measures should be considered to conserve water through improving water use efficiency.

2. Measures should be considered to increase the cold water storage capacity at project reservoirs.

3. Measures should be considered to increase spawning habitat availability above Centerville powerhouse through gravel augmentation.

4. Measures should be considered to limit recreational access to facilities within the range of holding and spawning CV spring-run Chinook salmon from July through October.

5. FERC and PG&E should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within Butte Creek.

To be kept informed of actions minimizing or avoiding adverse effects, or benefiting listed and proposed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

XI. REINITIATION OF CONSULTATION

This concludes early consultation on the proposed issuance of a 50-year license for the PG&E DeSabla-Centerville Hydroelectric project (FERC No. 803). FERC may ask NMFS to confirm this preliminary biological opinion as a final biological opinion on the prospective action once FERC receives the license application from PG&E. The request must be in writing. If NMFS reviews the proposed action and finds that there are no significant changes in the action as planned or in the information used during the early consultation, we will confirm the preliminary biological opinion as a final biological. Additionally, NMFS cannot confirm the biological opinion as final until we have completed an analysis of project-related effect on CV steelhead and their critical habitat. Also, reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in any incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action, including the avoidance, minimization, and compensation measures listed in the *Description of the Proposed Action* section is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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APPENDIX A

2005 PROJECT OPERATIONS AND MAINTENANCE PLAN

ORIGINAL

Pacific Gas and Electric Company

Power Generation

245 Market Street
San Francisco, CA 94105

Mailing Address
Mail Code N11C
P.O. Box 770000
San Francisco, CA 94177

FILED
OFFICE OF THE SECRETARY
2005 JUN 28 P 2:38
FEDERAL ENERGY REGULATORY COMMISSION

June 23, 2005

Honorable Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

**Re: DeSabla - Centerville Project (FERC No. 803)
2005 Operations and Maintenance Plan.**

Dear Secretary Salas:

Pursuant to the Commission's August 20, 1998 order, Pacific Gas and Electric Company (Company) hereby submits its 2005 Operations and Maintenance Plan (2005 Plan) for the DeSabla Centerville Project (Project).

The attached 2005 Plan is similar to the 2004 Plan and addresses the operation of the Project during the summer period, continues a water temperature monitoring program and provides a forecasting approach to detecting changing summer weather conditions in a timely manner. The plan also contains proposed provisions for winter and emergency operation that the Coampany and the resource agencies anticipate will be discussed further and finalized prior to the winter of 2005/6. Consistent with the Commission's August 20, 1998 order, this Plan has been prepared in consultation with the National Marine Fisheries Service (NOAA Fisheries), the California Department of Fish and Game (CDFG), and the U.S. Fish and Wildlife Service (FWS). A draft 2005 Plan was submitted to these agencies by letter dated May 2, 2005. FWS and NOAA Fisheries provided comments on the draft plan by Email on June 6 and June 13, respectively. A revised 2005 Plan was submitted to the agencies on June 20 and the Company has confirmed that CDFG, FWS and NOAA Fisheries are in agreement with the June 20 version of the 2005 Plan.

If you have any questions, please call me at (415) 973-1646.

Sincerely,

Bill Zemke

Bill Zemke
Senior License Coordinator

Attachment

Original plus eight copies to FERC

Honorable Magalie Roman Salas, Secretary
June 23, 2005
Page 2

cc: Ms. Deborah Giglio
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Sacramento, CA 95825

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Oroville, CA 95965

Attachment

June 20, 2005

Project Operations and Maintenance Plan - 2005
Pacific Gas and Electric Company
DeSabla-Centerville Project (FERC No. 803)

The objective of this Operations Plan is to focus on how to best protect water quality and provide flows and water temperatures that are as cold as possible to support to holding, spawning, and rearing of spring-run Chinook salmon in the reaches of Butte Creek below the Quartz Bowl Pool and below the Centerville Powerhouse during 2005. This Operations Plan outlines the procedures and practices followed by the Pacific Gas and Electric Company (Licensee) in the operation and maintenance of the DeSabla Centerville Project (Project) facilities to enhance and protect this habitat for spring-run Chinook salmon. This Operations Plan is also intended to provide the basis for modification of the reservoir temperature release criteria established in the FERC's August 21, 1997 order, as amended by its August 20, 1998 order.

On October 4, 2004 the Licensee filed its Notice of Intent to file an Application for New License and elected to pursue the new Integrated Licensing Process (ILP). The ILP process is expected to produce an agreed-upon list of study plans to be carried out over the next several years to assist in the preparation of the Licensee's Application for New License for operation beyond 2009.

A. Introduction

1) The DeSabla – Centerville Project includes the following features:
   Reservoirs and Forebays:
      Round Valley Reservoir (also called Snag Lake), Philbrook Reservoir, and DeSabla Forebay
   Canals and related features:
      Butte, Hendricks, Toadtown, Upper Centerville and Lower Centerville and associated diversion dams, feeders and spillway channels
   Powerhouses:
      Toadtown, DeSabla and Centerville

2) Project benefits to Butte Creek habitat include:
   a) Increased flow available to Butte Creek – Diversion of water from the West Branch Feather River (including releases from Philbrook and Round Valley Reservoirs) to Butte Creek increases the total flow available below Centerville Powerhouse by approximately 40% in July and August.
   b) Cooler water temperatures – The additional imports from the West Branch can provide cold water as a result of cold springs and releases from Philbrook Reservoir when the reservoir elevation is high. The increased flow from the West Branch also helps minimize heating in DeSabla Forebay by reducing the residence time. The shorter travel time of water in canals and greater shading than stream channels also conserves cold water temperatures.

June 20, 2005

c) Transport of water also allows for the allocated distribution of cold water for the primary reaches of Butte Creek that are used by spring-run Chinook salmon for over-summering and spawning.

3) Background:
   a) The Project storage reservoirs (Round Valley and Philbrook Reservoirs) are located on the West Branch watershed. Project diversions are made from this drainage at the Hendricks Canal Head Dam. Due to the larger size and depth of Philbrook Reservoir (5000 acre-feet) relative to Round Valley Reservoir (1200 acre-feet), the water temperature tends to stay cooler for a longer period of time in Philbrook Reservoir. Accordingly, since 1998 Licensee has released water from Round Valley Reservoir first, as soon as space is available in the Hendricks Canal, in order to effectively manage the temperature of water released into Butte Creek. Releases from Round Valley Reservoir typically begin in mid- June in normal water years and continue for a period of about one month. Philbrook releases are typically held until releases from Round Valley begin to diminish. The release valves from these reservoirs must be operated manually and the travel time of the water released from these reservoirs to Lower Centerville Diversion Dam (LCDD) is approximately 21 to 29 hours. Operator travel time to the valve locations is approximately 1½ hours during workdays and may be up to 4 hours on weekends.

   b) On August 21, 1997, the FERC issued an order placing temperature restrictions (17°C at Round Valley and 18°C at Philbrook) on the releases from these dams. On August 20, 1998 the FERC revised its order to allow for modification of the criteria upon mutual agreement of the National Marine Fisheries Service (NOAA Fisheries), the California Department of Fish and Game (CDF&G), and the U. S. Fish and Wildlife Service (FWS) (collectively, the Resource Agencies). Since 1999, this agreement has been accomplished by way of an annual operations plan for these reservoirs. The reservoir operation varies based on expected water year conditions. Pursuant to FERC's August 21, 1998 order, this Operations Plan is annually updated and modified as appropriate in consultation with the Resources Agencies.

B. Normal Reservoir Operations:

The proposed 2005 Operations Plan, based on average water year criteria, is as follows:

1) To minimize the potential for water temperature increases in Round Valley Reservoir and preserve the cool water benefits of Philbrook Reservoir, Licensee will begin releasing water from Round Valley Reservoir as soon as capacity is available in the Hendricks Canal.
2) Philbrook Reservoir releases will be initiated as Round Valley Reservoir nears its minimum elevation so as to avoid a drop in canal flows when Round Valley Reservoir flow runs out. Licensee will closely monitor the drawdown of Round Valley Reservoir as the minimum elevation is approached.
3) Philbrook Reservoir releases will initially be made at a steady release rate of approximately 10 to 15 cfs until such time as an increase may be made for an extreme heat event as provided

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under Section (C) below. Factors to be considered in establishing the actual rate of release include the date upon which releases commence, the objective of reserving cold water for a possible extreme heat event, the level of background flows, and the objective of maintaining flows through DeSabla Forebay of no less than 80 cfs. If an extreme heat event does not occur prior to August 1, Licensee will consult with the Resource Agencies regarding whether to increase this release level to compensate for the reduction in background flow in the West Branch. If an extreme heat event does not occur by August 15, Licensee will consult with the Resource Agencies regarding whether to increase this release level an additional amount to spread the remaining water in Philbrook Reservoir out over the period through at least mid-September.

4) Increased monitoring of water temperatures will continue in 2005 to help support the development of a water temperature model to use in future operations evaluations. (See Monitoring Section below).
5) DWR gage BW12 will be used as the indicator of water temperatures in the Project waters. If requested by the Resource Agencies, daily water temperature readings will be taken at LCDD if water temperatures at BW12 exceed 16°C for a period that is determined to be appropriate. PG&E will evaluate the potential for placing temperature monitoring devices at BW98 (immediately below LCDD) and immediately below Centerville Powerhouse to provide real-time information on water temperatures. PG&E and the resource agencies will consider if such information could assist in better management of the water resources available and consider future changes to this plan that may be appropriate.
6) It is anticipated that this Operations Plan will be updated annually in consultation with the Resource Agencies and filed with the FERC pursuant to the FERC's August 20, 1998 order.

C. Contingency for Extreme Heat Event

In anticipation of a possible high ambient air temperature excursion, as was experienced in 2002 and 2003 (but not in 2004); the following actions will be taken:

1) Starting on June 13, Licensee will prepare a weather forecast for the DeSabla-Centerville Project Area by noon each Monday and Thursday. The weather forecast will be based on information from USFS weather stations at Cohasset and Chester. Licensee will provide an e-mail copy of the forecast to NOAA Fisheries, CDF&G and FWS. If air temperatures in excess of 105°F for two or more days during the next seven day period are forecasted at Cohasset, with the potential for compression heating at higher elevations as confirmed by data from the Chester location, Licensee will send an e-mail to all, and phone at least one of the individuals at the Resource Agencies identified in paragraph 5 below advising them that an extreme heat event is forecasted. If the next forecast confirms that an extreme heat event has started or is imminent within the next two days, and is expected to continue for over two days, Licensee will send a second e-mail, phone, or fax each of the Resource Agencies to discuss actions to be taken. If personal contact can not be made and PG&E still believes action needs to be taken, it will initiate efforts to modify Project operation as discussed in paragraphs 2 – 4 below. If action is taken, a fax will be sent to CDF&G and NOAA Fisheries.

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2) If releases are being made from Round Valley Reservoir at the time of the second forecast confirming an extreme heat event, then the releases from Round Valley Reservoir will be reduced by approximately 50% and the release valve at Philbrook Reservoir will be opened to provide a total release of up to 35 cfs if determined to be appropriate.
3) The actual amount of water released from Philbrook Reservoir during a confirmed extreme heat event will depend on Licensee's assessment of then-existing conditions and recommendations and comments received from the Resource Agencies in response to the e-mails.
4) At the next forecast date, if temperature forecasts have returned to normal levels, Licensee will reduce the releases at Philbrook Reservoir to the pre-event level and assess the quantity of water available for the remainder of the season. If temperatures forecasts have not returned to normal, Licensee will consult with the Resource Agencies regarding whether to continue or adjust the releases based on the then-existing conditions.
5) The individuals to whom Licensee will send e-mails under this section are:
   Paul Ward – California Department of Fish and Game (pward@dfg.ca.gov)
   Tracy McReynolds – California Department of Fish and Game (tmcreynolds@dfg.ca.gov)
   CDF&G phone number 530-895-5015, fax 530-895-5031
   Howard Brown – NOAA Fisheries (howard.brown@noaa.gov) 916-930-3608
   Mike Aceituno – NOAA Fisheries (michael.e.aceituno@noaa.gov) 916-939-3623
   NOAA Fisheries phone number – 916-930-3601, fax 916-930-3629
   Deborah Giglio – US Fish and Wildlife Service (Deborah_giglio@fws.gov) 916-414-6738
   FWS phone number – 916-414-6600, fax – 916-414-6713
   Diana Shannon – Federal Energy Regulatory Commission (Diana.Shannon@ferc.gov)

D. Release Modifications at/below Lower Centerville Diversion Dam (LCDD)

Increasing the releases to Butte Creek at the LCDD will continue to be considered. Current data does not support increasing flows below LCDD during the summer months, due to the potential adverse impacts such releases may have on the water temperature below Centerville Powerhouse. However, increased releases below LCDD during the spawning period (i.e., after approximately mid-September) may provide additional spawning habitat in the reach below LCDD. During the 2004 spawning season the release at LCDD was increased to the estimated natural flow in Butte Creek (60 cfs). Accordingly, Licensee will consult with the Resource Agencies over the course of the summer to determine if and when releases below LCDD during the 2005 spawning period can be implemented without adversely impacting water temperatures below Centerville Powerhouse. For 2005, the flows below LCDD will be increased after mid-September up to the total of the mid-September natural flow of Butte Creek plus the flow that is being diverted in mid-September from the West Branch Feather River; this is the same as the total of the flow being released before mid-September to the bypass reach (40 cfs), plus the flow going down the Centerville Canal in mid-September less any releases from storage on the West Branch. The specific quantity of flow available will be determined at that time based on the actual combined flow at that date ("Mid-September Flow"); however it is currently estimated to be a total flow of approximately 80 to 100 cfs. Flow contributions originating from the West Branch Feather River will be subject to the continued availability of the West Branch Feather River diversion and the Hendricks and Toadtown canals. If implemented, increases in flow for spawning will be

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continued through February 28, 2006, or other appropriate date determined in consultation with the Resource Agencies. If implementing the "Mid-September Flow" below LCDD requires that operation of Centerville Powerhouse be temporarily discontinued, the powerhouse may be re-started using any flows above the "Mid-September Flow" that may subsequently become available.

E. Project Winter and Emergency Operation THIS SECTION HAS NOT BEEN FINALZED. HOWEVER, IT CONTAINS PROPOSED PROVISIONS THAT WILL PROVIDE THE BASIS FOR FURTHER DISCUSSION PRIOR TO THE START OF THE 2005/6 WINTER SEASON.

1) Maintenance Outages Scheduling - To minimize the disruption of flows in Butte Creek during times that are sensitive to salmonids in Butte Creek, Licensee plans to take scheduled canal outages as early as possible in the year.

2) Restoration of Flows in the Lower Centerville Canal - When the Lower Centerville Canal is restored after an outage or when the flow in the canal is increased, Licensee will attempt to make an orderly increase in the flow to the canal while also minimizing the length of time that a spill may occur at the Centerville Powerhouse spill channel within the operating limitations of the Centerville Powerhouse generating units.

   Newly emerged fry in Butte Creek appear to be most vulnerable to stranding because of their limited swimming ability, their tendency to use the substrate as cover, and their preference for shallow river margins. As juveniles grow, they tend to move to deeper, higher-velocity water associated with main channel habitats where they are less susceptible to stranding. Small fry could be present from as early as mid-November (spring-run Chinook) into July (steelhead). This covers the period of time when outages and canal flow reductions for storms and maintenance activities are most likely to occur and the ramping rates provided below will be used in those months.

   The proposed ramping rates were derived from an analysis that evaluated the stage-discharge relationship for three FWS 2-D instreamflow study sites located in vicinity of Helltown Bridge. The stream morphology and noted heavy spawning use in the Helltown Bridge area makes these three sites well suited for evaluating stranding potential. The ramping schedule incorporates the study results for all three study sites combined and identifies a range of flows where ramping can occur without exceeding a 0.1 ft/hr change in water surface elevation. The 0.1 ft/hr ramping rate is supported by the literature and is a rate adopted by the resource agencies and PG&E for the Battle Creek (FERC 1121) Salmon and Steelhead Restoration Project.

   From August through mid-November the potential for stranding should be significantly reduced because of the larger size of juvenile steelhead and Chinook present at that time. In the unlikely event that canal flow restoration is required during this period, and a higher ramping rate is desirable, Licensee may consult with CDF&G and NOAA Fisheries on the appropriate ramping rate to protect small juvenile salmonids tat can occur during scheduled and forced outages.

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Flow in Butte Creek prior to the adjustment	Objective maximum change in diversion rate to Lower Centerville Canal
Above 270 cfs	40 cfs/hr.
210 cfs – 270 cfs	35 cfs/hr.
170 cfs – 210 cfs	30 cfs/hr.
130 cfs – 170 cfs	25 cfs/hr.
90 cfs – 130 cfs	20 cfs/hr.
50 cfs to 90 cfs	15 cfs/hr.

3) Unusual conditions such as winter storms, disruption in canal flows caused by slides or fallen trees, and unexpected electric transmission system outages can disrupt normal Project operation. Licensee shall use its best efforts to minimize impacts that may result from such unusual conditions, including the actions outlined below:

   a) Unit Separation from Load - If the electric transmission system, the generating unit or a critical support system experiences a problem, the generating units automatically separate from the load and the flow of water to the units must be directed away from the units. At the Toadtown and DeSabla powerhouses this is done by means of a bypass device that directs the flow through an energy dissipater bypass and allows the water to continue moving at approximately the same flow levels. The Licensee will adjust the automatic opening level during the summer to reasonably correspond to the operational level of the powerhouse. The shift from the generating unit to the bypass facility may result in a minor release of turbidity caused by sediment that may have built-up in the bypass device since its last use. If the outage is expected to last for an extended period of time, the flow in the canal is shut-down. At the Centerville Powerhouse a mechanical bypass does not exist and when the unit is shut down the flow in the canal is released into a spill channel at the header box at the top of the penstock. This spill channel is an unlined ditch approximately 2500 feet long with a bed consisting primarily of rocks and boulders. The initial spill down this channel can result in some turbidity caused by accumulated leaves and dirt that may have slid into the channel since its last use. After the channel has operated for a period of time, turbidity is typically not a concern.

   b) Other Uses of the Centerville Spill Channel - In addition to emergencies, two other situations can result in the use of the spill channel. These include some occasions when the Centerville canal or powerhouse is started-up or shut-down for normal maintenance and when only the small generating unit at Centerville is operating. The generating units at Centerville Powerhouse have various operating limitations that restrict their operation at low flows. The large unit at Centerville Powerhouse has a normal operating restriction limiting its operation to no less than 25% gate. However, Licensee has recently determined that it is safe to override this restriction for short periods of time such as canal start-up and shut-down. This is expected to help reduce the occurrence of spill in the spill channel during canal start-up and shut-down. The other situation occurs if canal flow drops to a level that the large unit can no longer be operated and the load is switched over to the small unit. The ability of this unit to maintain a steady flow is impaired and, as a result it is necessary to maintain a spill of 5 to 10 cfs at the header box when only the small unit is operating. This situation typically occurs only in the fall months in September and October. During times of flow in the spill channel, Licensee will visually inspect the water in the channel at times when an operator is present. If turbidity is present, Licensee will investigate the source of the turbidity and make reasonable attempts to take corrective action.

c) Winter Operation and Canal Emergencies – Much of the Project's canal system traverses steep forested lands. During times of high rainfall and/or high winds, slides, rockfalls and fallen trees can damage canals or block flows. To minimize the potential for damage in the event of a blockage or failure of a canal or flume Licensee may reduce canal flows in advance of such events. In addition, emergency spill gates are located at several locations and equipped with devices that can be operated remotely to spill water. At numerous locations along the canals, Licensee has installed sensors that report canal flow levels to the operator at Rock Creek Powerhouse. This location is staffed 24 hours a day, 7 days a week. If a sensor detects an unexpected change in the flow, an alarm is sent to alert the operator. The operator will then dispatch personnel to the location and can take immediate action to start removing water from the canal by activating an emergency spill gate. The emergency spill gates are placed at locations where the channel through which the water will travel is generally protected by rocks and boulders. However, turbidity is possible from vegetative or other debris that may have accumulated in the channel since its last use. Spill channels are routinely inspected at the beginning of the winter season and are typically operated once during a winter high flow event to maintain the prescriptive right for the spill channel and keep the release gate clear of material. This operation will result in an incremental increase in the turbidity of Butte Creek for a short period of time, which is typically already elevated during high flow event. Operation of the spill channels that may not be well protected and could likely result in turbidity increases, other than the annual winter operation discussed above, will be operated for emergency purposes only. To avoid releasing water into a damaged canal after a storm event, the canal is patrolled on foot prior to increasing the flow into the canal.

F. Monitoring

1) Licensee will continue an expanded monitoring program during 2005 consistent with efforts anticipated for the upcoming relicensing study effort. Temperature monitoring will generally be conducted between June and September. Monitoring locations are identified in Exhibit A.

2) Prior to the start-up of a canal or powerhouse after an outage, which may result in the release of turbidity to Butte Creek, Licensee will monitor water quality for a period of up to four

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hours. The location for such monitoring will be the bridge downstream of Centerville Powerhouse (for Centerville start-up) and the LCDD (for DeSabla start-up).

3) In the event of a canal failure, spill gate operation or other release that results in a potential release of turbidity to Butte Creek, Licensee will secure water quality samples to the extent practicable and taking into consideration personnel safety. The monitoring will be conducted using grab samples collected by Licensee and tested for turbidity and settleable solids. Sampling locations will generally be immediately upstream of the dam or point of diversion and approximately 300 feet downstream of the point of release or return to surface waters. If the point of release to surface waters is not reasonably accessible by vehicle, Licensee will sample at the nearest downstream location that can be safely and readily accessed.

4) Water quality sampling data will be made available to the Resource Agencies in a timely fashion.

5) Licensee will continue to fund in 2005 the pre-spawning mortality study efforts coordinated by CDF&G similar to the effort provided in 2003 and 2004.

H. Ongoing Consultation

1) Licensee will meet at least annually with the interested Resource Agencies to discuss and review this Operations Plan. In addition, Licensee will continue to provide updates (generally by e-mail) on Project operations and events of interest to the Resource Agencies. A summary report will be prepared on annual operations and monitoring data, which will include water and air temperatures, reservoir and conveyance operations and actions taken to minimize effects on listed fish species.

2) Nothing in this Operations Plan will be construed as modifying any of the terms and conditions of any license issued by the FERC or in any manner limiting the jurisdiction of the FERC. In the event of any conflict between any of the provisions of this Operations Plan and an FERC license, the provisions of the license will control.

3) Licensee will work with the Resource Agencies, and other agencies as appropriate, to seek ways to promote prudent land management practices by others where such practices may directly or indirectly impact safe, reliable canal operations. Nothing in this Operations Plan will be construed as either the Licensee or the Resource Agencies accepting responsibility for conditions or damage that may be the result of the actions, or inactions, of others.

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EXHIBIT A - WATER QUALITY MONITORING LOCATIONS – 2005

(Actual locations subject to change depending on ability to secure access rights)

Station Work Group		Station ID	Description	Activity	Temp Recorders	Flow Recorders	Met Stations
Upper West Branch NFFR	1	RVR	Round Valley Reservoir	IN, PR	—	HG	
	2	WBFR1	WBFR blw RVR	TR, IN	1	HG	
	3	CHC	Coon Hollow Crk	TR, IN, S	1	S	
	4	WBFR2	WBFR blw confluence with springs and Coon Hollow	TR, IN, S	1	S	
	5	WBFR3	WBFR abv confluence with Philbrook Crk	TR, IN, F	1	1	
	6	WBFR4	WBFR blw confluence with Philbrook Crk	TR, IN	1	(add 5&12)	
	7	LCC	Last Chance Crk	TR, IN, S	1	S	
	8	WBFR5	WBFR at Hendricks Head Dam	TR, IN	2	HG	
Philbrook Creek	9	PC1	Philbrook Creek abv Philbrook Reservoir	TR, IN, S	1	S	
	10	PCR	Philbrook Res.	TR-array, IN, PR	3	HG	M1
	11	PC2	Philbrook Crk blw dam	TR, IN	2	HG	
	12	PC3	Philbrook Crk at mouth	TR, IN, F	1	1	
Hendricks-Toadtown Canal	13	HTC1	Hendricks Canal at Long Ravine Div	TR, IN	1	HG	
	14	HTC2	Toadtown at TTPH	TR, IN	1	HG	
	15	HTC3	Toadtown at BW-12	TR, IN	1	HG	
	16	BTC2	Butte Canal abv TTC	TR, IN	1	HG	
	17	BTC3	Canal inflow to Forebay	TR, IN	2	(add 15&16)	
DeSabla Forebay	18	DSFBY	DeSabla Forebay	TR-array, IN, PR	2	HG	M1
	19	DSPH	DeSabla Powerhouse	TR, IN	1	HG	M2
Upper Butte Creek	20	BTC1/BC1	Butte Crk at Butte Head Dam	TR, IN	1	HG	
	21	ClrCk1	Clear Creek at diversion into Butte Canal	TR, IN, S	1	S	
	22	BC2	Butte Crk abv West Branch	TR, IN, F	1	S	
	23	WBBC	West Branch Butte Creek	TR, IN, S	1	S	
	24	BC3	Butte Crk abv Forks of Butte diversion	TR, IN	1	HG	
	25	BC4	Butte Crk abv DeSabla PH	TR, IN, F	1	1	
	26	BC5	Butte Crk at LCDD	TR, IN	2	HG	

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EXHIBIT A Table (Continued)

Station Work Group		Station ID	Description	Activity	Temp Recorders	Flow Recorders	Met Stations
Lower Butte Creek	27	CDFG S-7	Butte Creek at Quartz Bowl (CDFG)	TR	1	—	
	28	CDFG S-8	Butte Creek at Chimney Rock (CDFG)	TR	1	—	
	29	BC6	Butte Crk at Pool 4	TR, IN	1	—	
	30	CDFG S-9	Butte Creek at CDFG Pool 4 (CDFG)	TR	1	—	
	31	BC7	Butte Creek near Helltown	TR, IN	1	—	
	32	BC8	Butte Creek near Hawthorn property	TR, IN	1	—	
	33	BC9	Butte Crk abv Centerville Powerhouse	TR, IN, F	1	1	
	34	BC10	Centerville PH at Header box	TR, IN	1	HG	M1
	35	BC11	Butte Crk blw Centerville Powerhouse	TR, IN	2	(add 30&29)	
	36	BC12	Butte Crk abv Little Butte Creek confluence	TR, IN	1	—	
	37	CDFG S-10	Butte Creek at Centerville Estates (CDFG)	TR	1	—	
	38	CDFG S-11	Butte Creek at Cable Bridge (CDFG)	TR	1	—	
	39	—	Butte Creek downstream of Honey-run Bridge	Temp sensor	1	USGS	
Upper Butte Creek/Butte Canal	40	InCrk1	Inskip Creek at diversion into Butte Canal	TR, IN	1		
Feeder Diversions	41	KCrk1	Kelsey at diversion into Butte Canal	TR, IN	1		
Hendricks/ Toadtown	42	LR1	Long Ravine u/s of Hendricks tunnel	TR, IN, F	1	1	
Canal Feeder	43	LR2	Long Ravine near confluence with LWF	TR, IN	1		

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EXHIBIT A Table (Continued)

Station Work Group		Station ID	Description	Activity	Temp Recorders	Flow Recorders	Met Stations
Diversions	44	CR1	Cunningham Ravine u/s Hendricks Canal	TR, IN, F	1	1	
	45	CR2	Cunningham Ravine near confluence with LWF	TR, IN	1		
	46	LWF1	Little West Fork u/s Hendricks Canal	TR, IN, F	1	1	
	47	LWF2	Little West Fork u/s confluence with Cunningham	TR, IN	1		
Lower WBFR	48	WBFR6	WBFR above Cold Creek	TR, IN, S	1	BW8 + S	
	54 9	CldCrk1	Cold Creek	TR, IN, S	1	S	
	50	WBFR7	WBFR below Cold Creek	TR, IN	1		
	51	WBFR8	WBFR above Big Kimshew	TR, IN, S	1	S	
	52	BkCk1	Big Kimshew	TR, IN, F	1	1	
	53	WBFR9	WBFR below Big Kimshew	TR, IN, F	1	1	
	54	WBFR10	WBFR above Fall Creek (RM 21.5)	TR, IN	1	S	
	55	WBFR11	WBFR, pool on NFSL (RM 18.5)	TR-array, IN, PR	2		
	56	WBFR12	WBFR above LWF	TR, IN	1		
	57	LWB3	Little West Fork	TR, IN, F	1	1	
	58	WBFR13	WBFR below LWF	TR, IN, F	1	1	
	59	WBFR14	WBFR at Upper Miocene Div. (near RM15)	TR, IN, F	1	1	

1) List of stations has been proposed as part of the DeSabla-Centerville Relicensing Studies and could be modified based upon access restrictions by private landholders.

Activity Legend
TR = Temperature recorder (Seamon Mini or Vemco [±0.1°C calibrated error]).
TR-array = Vertical temperature array suspended from buoy in reservoir.
IN = Insitu monitoring (Dissolved oxygen, pH, Conductivity, Turbidity, TDS).
PR = Vertical temperature profile.
F = Temporary continuous flow station (Campbell Scientific CR510)
Temporary stations rated using traditional USGS stage-flow methodology.
S = Synoptic stage and flow measurements used to estimate flow record.

Flow Legend
1 Station where a temporary continuous flow recorder will be located.
S Station with flow based on periodic staff gage readings and flow measurements.
HG Hydro generation gage station

Met Legend
M1 Fully instrumented meteorology recorder (Campbell CR10x [Wind Speed, Direct, Rel. Humidity, Air Temperature and Solar radiation])
M2 Air temperature recorder; Wind Speed & Direction

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